AUGUST, 1921

JOURNAL

OF

ECONOMIC ENTOMOLOGY

Official Organ American Association of Economic Entomologists

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Published by
American Association of Economic Entomologists
Geneva, N. Y.

Entered March 14, 1921, as second-class matter at the Post-office at Geneva, N. Y., under the Act of Congress of March 3, 1879

JOURNAL
OF
ECONOMIC ENTOMOLOGY
OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS
VOL. 14 AUGUST, 1921 No. 4

THE FUTURE OF BEE DISEASE CONTROL

By E. F. PHILLIPS, *Washington, D. C.*

Discussions as to the best form of state activity in the control of the diseases of bees are frequent, and obviously not all the states are utilizing the best plan, since there is so much variation in the operations in the several states. These discussions of methods are usually for one of three purposes here given in the order of prominence in the discussions: (1) to obtain uniformity of laws and methods in order that better cooperation between the states may be brought about; (2) to obtain more efficient work in disease control; (3) to make the bee disease control work fit in with the modern trend with work which has similar objects. It seems best to review the whole subject in order to arrive, if possible, at a policy which can be uniform, efficient and modern.

To understand the problem fully it is necessary that we briefly review its history along several lines. The earliest laws usually provided for the appointment of an experienced beekeeper by the governor of the state or by some court. This is quite obviously not the best plan for it can scarcely be expected that these officials will be sufficiently conversant with the needs of beekeeping to appoint the right men to these offices. In spite of the good examples of men so appointed which may easily be offered, the plan is a poor one in principle and was poor in many cases in practice.

To remedy this defect a quiet campaign was begun some ten years or more ago to provide for different appointing power. It was obviously desirable that the appointing official shall have certain administrative functions, so that he might know that the person appointed is doing good work. The control of a brood disease requires a wide acquaintance with

the beekeeping of the state, a broad view of the subject and an ability to weigh facts in order to divide up the work judiciously. It is not a disparagement of the inspector to say that he needs supervision, for it should be obvious that the man whose work consists of the many details of the field work is almost certainly blinded to the broader aspects of the problem on which he is engaged.

When the work with bee diseases first began there were few states which had Departments to which the regulatory work in agriculture was assigned. Where such departments exist the inspection work, of course, belongs there. Even in such states, it must be admitted that the supervision given to the bee disease work has not always been efficient. Even in the poorest cases that might be cited, the work was uniformly better than that in the states where the bee inspector was a free lance.

In these states where there was then no regulatory department the more desirable plan seemed to be to place the supervision with the state entomologist, as the official most likely to have the proper regard for the work and the requisite ability to appoint the inspector and to supervise the work. At the 1907 meeting of the Association of Economic Entomologists the author[1] attempted to enlist the support of the state entomologists in this problem and he has not forgotten the kindly but emphatic way in which some of those in attendance made it clear that they did not consider it a part of their work to deal with diseases of bees. Since that time, however, there has been a change in the attitude of the state entomologists, evidenced, for example, in the keen interest manifested in the meetings of the apiculture section of the association and in the work which they have since undertaken in this field.

The earliest laws, as well as those still in operation, provide for the inspection of apiaries, either on request or at the option of the inspector. The plan of having inspection only on request has not proven efficient, as in many cases the inspector may be of service in places where he is not asked to go.

The laws further provide that where the advice or orders of the inspectors are not followed out within a reasonable time, sometimes specified in the law, the inspector is then authorized by law to destroy all infected colonies. Presumably the power thus granted is for the purpose of removing the danger of infection of other bees, but in reality it is a

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[1]Phillips, E. F., 1908. Bee diseases: a problem in economic entomology. JR. ECON. ENT. I, No. 2, pp. 102–105.

punishment for the beekeeper who does not do his duty as laid down in the law. If we, for the purpose of argument, assume that any part of such destruction is for the purpose of punishment, then the inspector becomes sole judge of the existence of disease, judge as to whether his orders have been carried out, the legal officer who brings action for prosecution and finally the marshall who carries out the provisions of the law in the way of destruction. Merely to mention these functions is sufficient to show that this is too much power to place in the hands of one man where there are property rights to be considered. In order to minimize this, it has sometimes been pointed out that a colony of bees suffering from disease has no market value and that to destroy it is not to destroy valuable property. No beekeeper really believes this argument for obviously the hives and material equipment are as good as if no disease existed, the wax in the combs may be saved and even the bees themselves may usually be saved by proper care.

In almost all cases, the laws provide that the inspector shall teach the beekeeper how to treat the disease found, and in some cases it is further provided that the inspector shall take whatever other steps shall be deemed desirable for the furtherance of beekeeping in the state. This would include other educational work and this provision of the law has been used to good advantage, even in states where no other educational work was being undertaken in beekeeping. It is obviously not the intent of most of these laws that an educational system would be built up for the furthering of beekeeping.

It is opportune that we review this subject to see in what way this inspection work has proven most helpful. Taking first European foulbrood, the control of this disease demands that the beekeeper provide those features which lead to colony prosperity in early summer so that the bees can throw off the disease. It therefore becomes necessary for the beekeeper so to provide for the deficiency of his locality that the bees may build up. It takes a better beekeeper to continue to keep bees in European foulbrood regions than is required in the average locality.

To overcome the deficiencies of a European foulbrood region requires good beekeeping and good beekeepers cannot be made by the exercise of police power. It has been shown most clearly that rigid inspection provisions and the enforcement of the provisions of the usual state laws are not of the slightest value in combating European foulbrood. The making of good beekeepers is so obviously a matter of education that it seems foolish to continue longer to try to control this disease by the enactment or enforcement of legislation.

American foulbrood may at first glance seem to be quite unlike the other serious brood diseases in that there is danger of the spread of the

disease through robbing out of colonies that have died of the disease It is evident that the careless beekeeper, or the one who desires to injure his beekeeping neighbors, can do much harm. Especially for this disease it is often recommended that rigid inspection be carried out and that those beekeepers who fail to treat the disease shall be punished as provided by law. Nothing will so insure a feeling of malice as punishment by the inspector, and it thus becomes a serious menace to the beekeeping of the region to apply the provisions of the law to those beekeepers who fail to do as ordered by the inspectors. Cases are known in which this disease has been spread intentionally, and the damage done is usually far greater than that brought about by normal spread.

The proper treatment of American foulbrood can be applied only by a beekeeper who has been taught how to treat the disease. The ignorant beekeeper often does more harm than good when he conscientiously tries to do what the law requires. The problem is therefore strictly one of education, the training of the beekeepers in the region where the disease exists how to combat it. In a few cases the inspector has felt that his duty is done when he finds the disease, marks the hives and orders a clean-up. Such work is practically valueless, and when the beekeepers of a region find that their inspector is doing that kind of work they usually ask for his prompt removal. So-called sacbrood is not sufficiently serious to need any inspection but only by education may this condition be distinguished from the other brood diseases.

The question then arises as to what should be done about the adult diseases about which there is so much discussion in the beekeeping press. The cause of none of these is known, unless perchance *Nosema apis* actually does damage; there is no rational treatment that can be recommended and the only thing that can be done is to take good care of the bees so that the troubles may disappear. There does not seem much for a police officer to do under such circumstances. There is really not much that the educator may do except to reduce the fear of the beekeeper who sees some bees die and who takes at their face value the alarming articles that appear from time to time.

The only remaining question is whether there is some disease of bees that is dangerous to the welfare of the industry and which is not widespread. If this were the case, then beekeepers might rightly ask for the quarantine of bees from that area. So far as we are able to judge, European foulbrood is now present in practically every locality where it can do damage, and even where it is present it is doing little harm to the good progressive beekeepers. American foulbrood is present in almost all parts of the United States, certainly present in every state where

there is any probability of beekeeping being a large industry. It would be a serious thing to have quarantines established or legalized further than they are now for the quarantine powers have already been abused, as is the keeping out of competing honey from certain markets under the guise of disease control. In no case that has come to the attention of the author has a quarantine been of any real value to the beekeeping industry.

Not only has police power not been extensively used, but the very existence of the power has been recognized as a handicap to the work. This is illustrated by the fact that Iowa has seen fit to call the official who corresponds to the apiary inspector by the name "State Apiarist". Pennsylvania has an "Apiary Adviser" and other states have in the same manner tried to hide the power granted to these men. That police power is a handicap is further shown by the fact that it has long been widely recognized that the county system of inspection is a failure. The trouble is that a beekeeper can not go to a neighbor beekeeper and get him to clean up the disease that may be present without engendering the thought that the work is done so that the region may be made better for the inspector or that the bees of the region may actually be killed off for his benefit. Were it not for the existence of the police powers of the inspector, a local man might efficiently serve, for there would not be the same feeling against an avowed educator.

The exercise of general police powers is dangerous to the beekeeping industry, yet there may be cases where a show of power may be helpful. In order that such hypothetical cases may be covered, the new Iowa law provides that in case the state apiarist shall find neglected disease he may report the case to the local officials charged with the enforcement of the other laws of the state and county and these local officials shall then take charge of the case. In New York, where inspection has been carried on since 1899, there have been few occasions where an exercise of police powers seemed wise. If the beekeepers still wish the power to be retained the law may be modified as in Iowa. In states where there is a department of the state government which has charge of the regulatory laws of agriculture, this power should be put in the hands of that department.

It seems that the beekeeping industry has been able to obtain the services of a competent lot of teachers of beekeeping throughout the country under the guise of having inspection for the prevention of the spread of the diseases of bees. That the work has been of the greatest good to the beekeeping industry is beyond question to any one familiar

with the details of the work,[2] and it is impossible to overestimate the value of this effort. It may seem somewhat strange that so great good has come from this work when it must be admitted that the inspectors have not done the things that are provided by the law.

At the time that the first of these laws were passed it would have been folly to go to a state legislature and ask for money for the education of the beekeepers of the state. The legislators were, however, willing to provide funds for the eradication of the diseases which were and still are causing trouble to the beekeepers, and in almost all cases the work once begun has been continued. The inspectors found the beekeepers ignorant of the diseases, not willfully negligent, and they soon saw that the right way to get these diseases under control was to teach the beekeepers how to care for their bees so that the diseases would do little harm. They further saw that many beekeepers were not practicing the right methods in other phases of their beekeeping work, and it was natural that a man good enough to be chosen as an inspector should be willing and glad to help his fellow beekeepers in every way possible. There soon grew up a system for the education of the beekeepers of the states. The defects that appeared, and which it was tried to overcome, in the way of appointment and supervision, were incident to education rather than to police inspection.

The work now so well known under the name "Extension" was begun but a few years ago and this educational work has proven so useful that it is now nation-wide. With the passage of the Smith-Lever Law this work was made a matter for cooperative action between the Federal Department of Agriculture and the Extension Divisions of the agricultural colleges of the several states established for the purpose. With the spread of this work, the value of an attack against poor agriculture by means of education became evident and it is no longer necessary to argue for it. Educational work of a similar character had long been done in many lines of agriculture, but very little has been done for beekeeping by the agricultural colleges. Beekeeping had its "extension men" however in many of the states, these men working under the apiary inspection laws. Extension work in beekeeping thus anticipated the general work in agricultural extension by several years.

In 1916 the Bureau of Entomology began extension work in beekeeping in cooperation with the extension divisions of several states and this work was advanced rather rapidly because of the war. The work is

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[2]Phillips, E. F., 1916. The results of apiary inspection. Read at Apiculture Section Meeting, Assn. Econ. Ent. New York: JR. ECON. ENT. 1917.

well under way and is in great demand, not only from beekeepers but from the extension divisions. This work differs somewhat in character from that done by the inspectors in that in addition to the emphasis placed on disease control an effort is made to remedy the defects of beekeeping practice as they are seen from a nation-wide view of the beekeeping industry. It is work of the same type, usually being done by beekeepers better prepared for educational work than are the inspectors.

If we are to have any changes in these state laws, therefore, they should be along the lines previously indicated and the new laws should contain the following provisions:

(1) An elimination of the police powers of the persons appointed under the law.

(2) The placing of this work under the supervision of the extension division of the agricultural colleges of the several states.

(3) The placing of whatever regulatory measures are deemed necessary with the regulatory offices of the state, entirely apart from the agricultural colleges.

(4) A retention of the interest of the entomologists who have taken so active a part in the development of the present educational system as state leaders in this work, in order that they may still continue to supervise it.

This policy will eliminate politics, provide adequate and necessary supervision, bring about uniformity, automatically insure cooperation among the several states as is not now possible, and, finally most essential, it will get results.

In presenting this problem for consideration, the author is advocating nothing new but is attempting merely to outline the present tendency in this work in order that those interested may more efficiently ask for what they want. The recommendations concerning state laws which the author has made in the past are essentially in harmony with the plan here outlined and recommended. The actual methods of inspection advocated are harmonious with the educational aspect of the work however useless certain provisions of suggested laws may have been. The changes that have occurred in the apiary inspection work are those which must arise from the very nature of the problem that has confronted us and the movement herein outlined is an inevitable one. A clear recognition of this fact will prevent attempts to retard the work by the introduction of methods and ideas antagonistic to the evolutionary trend and antagonistic to the best interests of the beekeeping industry.

LATE FEEDING LARVAE INJURIOUS TO APPLE IN PENNSYLVANIA INCLUDING SEVERAL NEW INJURIOUS SPECIES

By S. W. FROST, *State College, Pa.*

One of the most serious problems confronting the Fruit growers of Pennsylvania is the control of various late feeding Lepidopterous larvae which mar the fruit of Apple. As maturity advances each year quantities of marketable fruit are seriously lessened by them. Many of the species gnaw large cavities into the sides of the fruit, making them worthless, a few burrow within the apples, while others produce small scars or blemishes on the surface. The last mentioned type, although often small in size, detract largely from the quality of the fruit and prevent them from being packed and sold as first class apples. This results in a lower percentage of marketable fancy fruit and consequently a tremendous loss in returns to the orchardist. A further loss is incurred by the large proportion of fruit which drop in spring as a result of the early attacks of leaf-rollers and other feeders.

From our studies of the habits of Lepidopterous larvae injurious to apple, it appears that some workers have been misled concerning the types of injuries and the species causing them. This may be because the field has not been carefully investigated. Few workers have studied the types of injuries of apples or correlated them with the work of particular larvae. Some isolated species or groups of species have been studied more or less in detail. Among these, Mr. Slingerland's paper on "Green Fruit Worms", is the most notable. Among those of more recent date is a paper by Fulton on "Insects injurious to Apple Fruit", in which some phases of the scarring of apple fruit have been discussed.

The work of the past deals chiefly with the early feeders of apple, leaving the field of late feeders almost untouched. Leaf-rollers, for example, have long been considered as most injurious early in the season. In referring to injuries produced by this group, most writers lay emphasis on the injury caused by the larvae webbing the leaves and fruit together and the cavities produced in the sides of the fruit while they feed from within these shelters. On the other hand little attention has been directed to the late feeding of Leaf-rollers or Bud-moths. Fulton (1918) mentions them very briefly. In our investigations the late feeders are an important factor and it has been found that over

fifty per cent of the leaf-roller injury to picked fruit are of the late type. The majority of these injuries occur two or three weeks prior to picking time. The larvae have been found abundant and feeding voraciously at picking time.

These late feeding larvae have not, in the past, been generally considered as a class by themselves. In Pennsylvania they form an important and conspicuous group containing many injurious species whose seasonal activities overlap to some extent with the early feeders. The Bud-moths, for example, feed early in the spring as well as late in the fall. The same is true of the Leaf-rollers. We have found, however, that although the species overlap, the types of injuries are distinct. The scars produced early in the summer heal over and at picking time appear as russety spots or cavities. The late injuries, however, remain fresh and do not become russety or even calloused.

The late feeding larvae may be divided into three general classes, namely; the Leaf-rollers, Bud-moths and Codlin moth together with other similar feeders. The former produce large and sometimes deep cavities while the second class usually make small cavities or blemishes on the surface. The Codlin moth, as is well known, may cause side injury or burrow into the center of the fruit. A particular type of injury frequently spoken of as "Pin-Hole Injury" may be caused by Bud-moths, Case bearers or other small feeders.

The research thus far carried on has revealed many of the species responsible for the late summer injuries to the fruit of apples. Among the Leaf roller group which have been found in Southern Pennsylvania, can be named the Oblique Banded Leaf-roller (*Archips rosaceana* Harris), a new injurious species, the Red Banded Leaf-roller (*Eulia velutinana* Walk.) and another new apple pest (*Amorbia humerosana* Clem.) The Oblique Banded Leaf roller is neither abundant nor a serious pest with us. The Fruit Tree Leaf-roller has not been found in the Southern part of the State. On the other hand the Red Banded Leaf-roller (*Eulia velutinana* Walk.) is exceedingly abundant and injurious and causes most of the late injury noticed in our region. The larva of this species is entirely green in color and resembles (*Eulia quadrifasciana* Fernald), which has been reported from apples in New York State. A recent survey of the State of Pennsylvania reveals the fact that *Stenoma algidella* Walk. is common and widely distributed.

There are two Bud-moths which are responsible for the late scars and blemishes produced on the fruit, The Eye spotted Bud-moth (*Tmetocera ocellana* Schiff) and a new injurious species, *Sparganothis idae-*

usalis Walk. Both species are abundant and injurious. *Sparganothis* resembles somewhat the common Bud-moth in size and in having a shiny black head and prothorax, but the body is olive in color.

Among the smaller late side feeders of apple may be mentioned the Codlin moth (*Carpocapsa pomonella* Clem.), the lesser apple worm (*Laspeyresia prunivora* Walsh) and the Lesser Bud-moth (*Recurvaria nanella* Hubner). Neither of the last two species have been found very abundant. *Recurvaria nanella* is, however, the more common and considering the many localities from which it has been reported in the Eastern States, it seems that this may be a more serious pest in parts of the country than the Lesser apple worm.

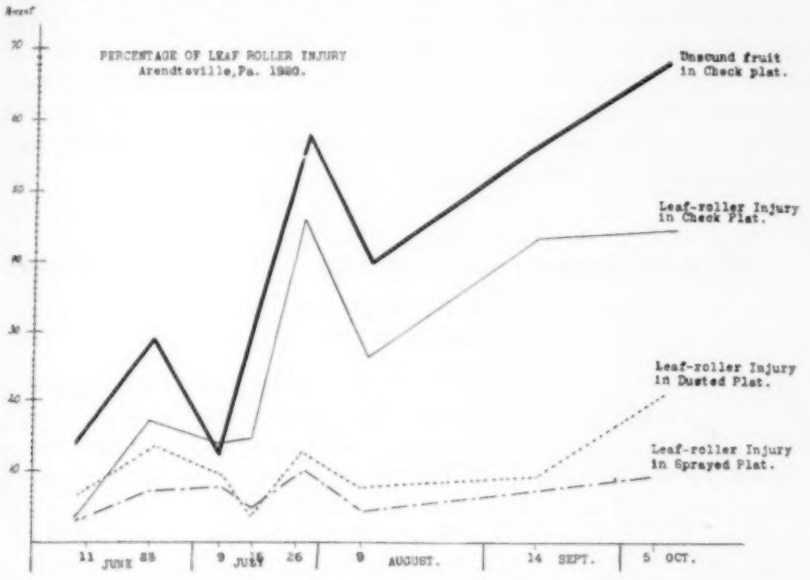
In making this hasty review of the situation as regards late feeders, it is hoped that we have been able to clear up considerable of the confusion existing both in literature and in the minds of many investigators of Fruit insects. Not only have the injuries been confused in the past but a lack of definite knowledge of the species of insect or their habits has made their control difficult. The discovery of the preceeding new injurious species and their late feeding habits has helped considerably to clear up the situation but there is still much work to be done.

Control measures against these species take into consideration spraying to poison the early spring broods of the various species. Our tests indicated that arsenate of lead in the dormant and delayed dormant sprays is important. We have been able to secure a much larger percentage of control in plots where both of these applications were included in the spraying program. Comparisons have been made with dust applications similarly applied, but as indicated in the accompanying diagrams, the liquid sprays have proven thus far the most satisfactory. The experiments clearly demonstrate that injuries from these late summer feeding lepidopterons can be materially reduced if orchardists practice consistent and thorough spraying during the early spring months.

Explanation Of Charts

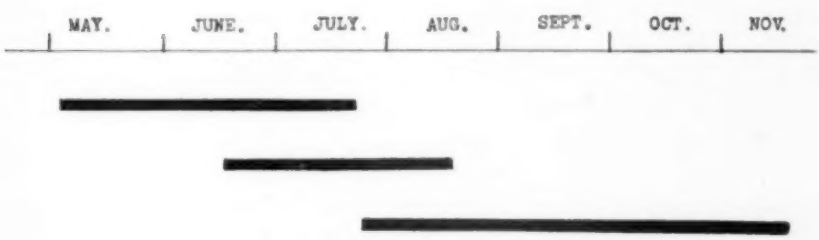
The following chart illustrating the percentage of Leaf roller injury was prepared from the examination of 29,482 drop fruits, approximately 10,000 fruits from each, the Check, Dusted and Sprayed plats. These were gathered throughout the summer from June 11th. to October 5th, as indicated on the horizontal axis. The curve for Leaf roller Injury unquestionably molds the curve for percentages of Unsound Fruit.

The latter curve is not absolutely comparable with the other curves because it represents the percentage of fruits while the other curves are the percentages of injuries. Hence we find that the curve for un-



sound fruit drops below the curve for Leaf-roller Injury in the Check on July 9th. The three high points of the Leaf-roller curve are indicative of the three generations of the Leaf-roller, *Eulia velutinana* Walk.,

CHART ILLUSTRATING THE NUMBER AND OVERLAPPING OF GENERATIONS OF Eulia velutinana Walk.



which caused the injury and is shown on the chart illustrating the number and overlapping of generations of this species. The curves for the Sprayed and Dusted plats indicate a considerable reduction in per-

centage of injury by Leaf-rollers in favor of the spray.[1] It will be further noticed that, in the check, the Leaf-roller injury reached it's climax late in the season.

The chart illustrating the Number of Generations was secured from larvae reared in confinement and checked with orchard conditions. The first two generations were reared through completely but the last generation was calculated from eggs laid towards the end of July. At this time and during the first of August newly hatched larvae were found abundant in the orchards.

STUDIES OF SANNINOIDEA OPALESCENS EDW. IN OREGON

By FRANK H. LATHROP, and A. B. BLACK, *Oregon Agricultural College Experiment Station, Corvallis*

In 1916 the Oregon Station undertook an investigation of the Western Peach and Prune Root Borer, *Sanninoidea opalescens* Edw. with Mr. G. F. Moznette in direct charge of the work. Upon the resignation of Mr. Moznette in 1917, the project was taken over by the senior author, who was later joined by the junior author in the prosecution of the work.

The formulation of an effective and economical means of control has been the primary object of the investigation. Life history studies have been conducted as a minor part of the work.

LIFE HISTORY STUDIES

WINTER CONDITIONS. Overwintering larvae seem to be active during warm periods and it is probable that some growth takes place during this season. Our observations show that during periods of cold rainy weather the larvae tend to leave their tunnels and work in the gum and frass as well as the soil immediately surrounding the tree. Many of these larvae lie dormant in silken cells which they spin against the tree trunk beneath the soil surface.

The winter cell is constructed with one side against the bark of the tree. In shape it is oval. The outer wall consists of a very thin silken membrane, concavo convex in form, forming a cell in which the lar-

[1]Six applications were made both to the sprayed and Dusted plats. A 90-10 Dust was used with the addititon of 1% Nicotine, as Nicotine sulphate. On the sprayed plats Lime Sulphur and Arsenate of Lead was used with the addition of Black Leaf 40 in the first four sprays.

va lies curled. The cell varies in size with the age of the larva which constructs it. We have found these cells ranging in width from five to twenty millimeters, and in length from eleven to twenty-five millmeters.

This habit of constructing winter cells seems to be much more pronounced in heavy, wet soils, than in more porous types.

Spring Activities. With the approach of spring the larvae become more active. Those which wintered in cells outside the trees resume their places in the tunnels under the bark. The more mature larvae soon spin cocoons in preparation for pupation. Cocoons were found at Roseburg as early as April 22, but were not found in great numbers until late May or early June. At Corvallis and the more northern portions of the State, these activities are more delayed.

Adults: Emergence, Feeding, Oviposition. During several years of field observation at Corvallis we have found that moths begin to emerge during the last week of June. The number of adults emerging increases until late July. The last week in July shows a decline in the numbers emerging. Living pupae have been collected in the field at Corvallis as late as August 12.

At Roseburg in 1919 moths began to emerge as early as June 18. July marked the period of maximum emergence. Moths emerged as late as August 15 from cocoons which had been placed in breeding cages.

We found that captive moths took readily—almost greedily—distilled water, and also a dilute sugar solution. In the case of females such feeding seemed to stimulate oviposition. No attempts were made to attract moths to bait solutions in the field.

We have found that oviposition ordinarily takes place soon after emergence. In the field, eggs are most frequently placed on the trunk of the tree, but occasionally on the larger limbs. In a few instances, females were observed to deposit eggs on the soil at the base of the tree. Specimens in small cages show much less selection and the eggs are deposited, on any part of the tree, including the leaves, and even on the wire and cloth of the cage.

Records were kept of the number of eggs deposited by females confined in small cages. Upon the death of each moth the body was dissected and the number of unlaid eggs also recorded

The results are shown in the following table:

TABLE I

Eggs	Moth Number 1	2	3	4	5	6	7	Average
Deposited	183	506	159	279	136	105	125	213.3
Dissected out	427	14	336	278	533	523	708	402.7
Total	610	520	495	557	669	628	833	616.0

LARVAL ACTIVITY. Upon hatching from the egg the young larva immediately attempts to bore its way into the bark of the tree. If it succeeds, a tiny pile of frass marks the point of entrance. The young larva spends a considerable part of its life tunneling in the corticular region of the bark. During this period it may travel a considerable distance, and it leaves behind a tortuous trail of darkened tissues just beneath the surface of the outer bark. We cannot say what is the length of time which the larva spends in this way, but we have found in these superficial burrows larvae ranging from newly hatched to fifteen millimeters in length.

Apparently upon reaching a length of fifteen or twenty millimeters the larva proceeds to form its typical tunnel in the cambium beneath the bark, which constitutes the characteristic injury so well known to peach and prune growers. These tunnels are linear in form, usually fairly straight, and extend vertically with the grain of the wood; although irregular, side tunnels are not infrequently found. We have found tunnels of this type as small as thirty two by seven millimeters. The complete tunnels usually vary in width from fifteen to thirty millimeters or more, and extend vertically to a length of one hundred to one hundred fifty millimeters or more. The most common location of these tunnels is at the crown of the tree; the upper extremity of the tunnel ordinarily extending some thirty millimeters above the soil surface, the lower extremity reaching some distance below the soil surface. We have frequently observed a round hole, approximately seven millimeters in diameter connecting the complete tunnel with the exterior just at the surface of the soil. This opening is not invariably present however, and many burrows are to be found without any apparent communication with the exterior.

The presence of larvae is not limited to the crown of the tree. Especially on rough bark trees larvae may be found working on the trunk and in the crotches. This species seems to show a greater tendency in this respect than does the Peach Tree Borer of the East, *Sanninoidea exitiosa* Say.

Experiments In Control

Our observations of the winter habits of the root borer larvae, led us to investigate the possibility of applying some substance during fall or winter which would destroy the larvae in their winter cells and possibly those which remained in the superficial burrows. A series of tests were applied as follows:

Plot 1.	Scalecide	1 pt.	Plot 5.	Nicotine Resinate	3 ozs.
	Water	7 qts.		Water	7 qts.
Plot 2.	Scalecide	1 pt.	Plot 6.	Check. No treatment	
	Sodium Arsenate	2 ozs.			
	Water	7 qts			
Plot 3.	Scalecide	1 pt.	Plot 7.	Fuller's Earth[1]	5 lbs.
	Nicotine Sulfate 40%	3 ozs.		Nicotine Sulfate 40%	¼ lb.
	Water	7 qts.			
Plot 4.	Nicotine Oleate	5 ozs.	Plot 8.	Sulfur dust	5 prts
	Water	7 qts.		Lead arsenate(powder)	1 pt.
				Tobacco dust	4 prts.

The soil was removed from the base of each tree to the depth of four to six inches. A generous amount of the liquid or dust was then applied and the soil replaced about the tree.

In no case was there a satisfactory control, and these substances do not seem promising. This failure does not necessarily indicate that treatment at this time is inapplicable, but some more satisfactory larvicide must be found before the treatment will be effective.

Miscible Oil - Sodium Arsenate Sprays

The fact that the young larvae spend a considerable period in the outer bark led us to hope that by using a soluble arsenate with miscible oil as a carrier, the corticular region of the bark might be so thoroughly saturated with poison as to kill the larvae as they worked in this region.

For this purpose the following formula was used.

[1]Miscible Oil No. 1. 1 pint.
Sodium arsenate 2 ounces
Water to make two gallons

[1]A commercial spray oil prepared by General Chemical Co., San Francisco, Cal.

This solution was applied by means of a small compressed air hand sprayer. A bordeaux nozzle was used, adjusted to throw a solid stream of considerable force. The solution was applied to the bases of the trees, from the soil surface to a height of approximately eighteen inches and some of the solution was puddled about the base of the tree. The following tables show the series of applications made, and the results.

TABLE II - SODIUM ARSENATE - MISCIBLE OIL APPLICATIONS
State Hospital Farm, Salem, Oregon, 1920

Row No.	Treatments: No. of applications	Treatments: Dates of applications	Results: Trees treated	Results: Trees wormed	Results: Date wormed	Results: Trees Infested No.	Results: Trees Infested %	Results: Number of Worms Total	Results: Number of Worms average per tree
D1	5	July 1, July 21, Aug. 26, Sept. 15, Sept. 30	16	5	Oct. 14 1920	4	80	10	2
D2	3	July 21, Aug. 26, Sept. 15	16	5	"	4	80	6	1.2
D3	2	Aug. 26, Sept. 15	16	5	"	3	60	4	0.8
D4	2	Sept. 15, Oct. 9	16	5	"	5	100	16	3.2
D5	1	Oct. 9	15	5	"	3	60	9	1.8
D6	3	July 1, Aug. 26, Oct. 9	16	5	"	3	60	5	1.0
C1	0	Check no treatment	0	5	"	4	80	25	5.0
C2	0	Check no treatment	0	5	"	5	100	13	2.6
C3	0	Check no treatment	0	5	"	4	80	8	1.6

TABLE III - SODIUM ARSENATE - MISCIBLE OIL APPLICATIONS
Busenbark Orchard, Roseburg, Oregon, 1920

Row No.	Treatments: No. of applications	Treatments: Dates of applications	Results: Trees treated	Results: Trees wormed	Results: Date wormed	Results: Trees Infested No.	Results: Trees Infested %	Results: Number of worms Total	Results: Number of worms average per tree
D1	4	June 28, July 16, Aug. 11, Sept. 4	20	5	Oct. 24 1920	2	40	2	0.4
D6	2	June 28, Aug. 11	20	5	"	1	20	1	0.2
49	0	Check no treatment	0	5	"	3	60	5	1.0

These results show that the treatment has failed to reduce infestation to a satisfactory extent.

Tree Washes

During the summer of 1920 rather extensive tests were made of white-wash and of Fuller's Earth wash containing various active agents, such as arsenate of lead, nicotine sulphate, naphthalene, etc. In applying all of these washes, the soil was removed from the base of the tree to the depth of about four inches. The trees were allowed to stand thus until next day, when the adhering soil particles were removed by means of a stiff brush. The wash was then applied as a paint by means of a white-wash brush, the trunks being coated to a height of fourteen to sixteen inches.

The formulas used were as follows:

Whitewash

Row A1. Quick lime 8 lbs.
Arsenate of lead (pd.) ¼ lb.
Salt 2 lbs.
Glue ¼ lb.
Nicotine Sulfate 40% 2 ozs.
Water to make thick paint.

Row A2. Similar to A1 with the addition of one pound of copper sulfate.

Row A3. Quick lime 8 lbs.
Salt 2 lbs.
Glue ¼ lb.
Naphthalene (flake) 12 ozs.
Water to make thick paint.

Row A4. Quick lime 8 lbs.
Arsenate of lead (pd.) ¼ lb.
Salt 2 lbs.
Glue ¼ lb.
Water to make thick paint.

Row A5. Quick lime 8 lbs.
Salt 2 lbs.
Glue ¼ lb.
Nicotine sulfate 40% 2 ozs.
Water to make thick paint.

Table IV - Whitewash Treatments, State Hospital Orchard
Cottage Farm, Salem, 1920

	Treatments				Results				
Row No.	No. of applications	Dates of Applications	Number of Trees Treated	Number of Trees Wormed	Date Trees Wormed	Trees Infested Number	Trees Infested Percent	No. of Worms Total	No. of Worms Average per tree
A1	2	July 2 Aug 26	17	5	Oct 13	4	80	8	1.6
A2	2	July 2 Aug 26	20	5	Oct 13	3	60	9	1.8
A3	2	July 2 Aug 26	13	10	Oct 13	2	20	3	0.3
A4	2	July 2 Aug 26	20	5	Oct 13	5	100	7	1.4
A5	2	July 2 Aug 26	20	5	Oct 13	4	80	10	2.0
C5	0	Check	0	5	Oct 13	5	100	16	3.2
C6	0	Check	0	5	Oct 13	5	100	22	4.4
C7	0	Check	0	5	Oct 13	5	100	19	3.8

TABLE V - WHITEWASH TREATMENT, BUSENBARK ORCHARD
Roseburg, 1920

Treatments					Results				
Row No.	No. of applications	Dates of Applications	Number of Trees Treated	Wormed	Date Trees Wormed	Trees Infested Number	Percent	No. of Worms Total	Average per tree
A1	2	June 28 Aug 11	20	5	Oct 24	3	60	6[1]	1.2
A2	2	June 28 Aug 11	20	5	Oct 23	3	60	6	1.2
A3	2	June 28 Aug 11	20	10	Oct 23	0	0	0	.0
A4	2	June 28 Aug 11	20	5	Oct 24	4	80	7	1.4
A5	2	June 28 Aug 11	20	5	Oct 24	0	0	0	.0
C17	0	Check	0	5	Oct 24	4	80	20	4.0
C21	0	Check	0	10	Oct 24	8	80	34	3.4
C24	0	Check	0	5	Oct 24	4	80	16	3.2

A study of tables IV and V will show that in general there was a distinct reduction of infestation in the whitewashed trees, although in some cases this is not much greater than may be accounted for by chance irregularity in distribution of infestation.

The rows (A3) treated with the wash containing naphthalene show up to best advantage. In the ten trees examined at Salem only two trees were found to be infested, and these harbored a total of only three larvae. The trees at Roseburg show up even better, and in the ten trees examined no infestation was found.

FULLER'S EARTH-MOLASSES WASH

In the course of our work a series of experiments was performed in an effort to develop a wash which would be more suitable than white wash as an application to the bases of the trees for root borer control. After preparing some forty different mixtures, we succeeded in preparing a wash which seemed to fulfil most of the requirements quite well. The wash is composed primarily of Fuller's Earth, molasses, and glue. This forms a very hard coating which is quite resistant to weather conditions, and shows a minimum of cracking.

The Fuller's Earth washes were applied in a series quite closely parallel with the whitewash series, as shown by the following formulas:

[1]One larva found in trunk above area of whitewash was not included in this table.

B1. Fuller's Earth 8 lbs.
Molasses (stock food) 4 pts.
Glue (granulated) 1¼ lbs.
Arsenate of lead 1 lb.
Nicotine Sulfate 40% 4 ozs.
Water to make thick paint.

B2. Similar to wash B1 with the addition of 1 pound of Copper Sulfate.

B3. Fuller's Earth 8 lbs.
Molasses (stock food) 4 pts.
Glue (granulated) 1¼ lbs.
Naphthalene (flake) 12 ozs.
Water to make thick paint.

B4. Fuller's Earth 8 lbs.
Molasses (stock food) 4 pts.
Glue (granulated) 1¼ lbs.
Derris (powdered) 1 lb.
Water to make thick paint.

B5. Fuller's Earth 8 lbs.
Molasses (stock food) 4 pts.
Glue (granulated) 1¼ lbs.
Arsenate of lead 1 lb.
Water to make thick paint.

B6. Fuller's Earth 8 lbs.
Molasses (stock food) 4 pts.
Glue (granulated) 1¼ lbs.
Nicotine Sulfate 40% 4 ozs.
Water to make thick paint.

B7. Quick lime 5 lbs.
Molasses (stock food) 4 pts.
Glue (granulated) 1¼ lbs.
Arsenate of lead 1 lb.
Nicotine Sulfate 40% 4 ozs.
Water to make thick paint.

TABLE VI - FULLER'S EARTH WASHES, STATE HOSPITAL ORCHARD
Cottage Farm, Salem, 1920

Treatments					Results				
Row No.	No. of Applications	Dates of Applications	No. of Trees Treated	No. of Trees Wormed	Date Trees Wormed	Trees Infested No.	Trees Infested per cent	No. of Worms Total	No. of Worms Average per tree
B1	2	July 2 Aug 26	19	5	Oct. 13	3	60	6	1.2
B2	2	July 2 Aug 26	20	5	Oct. 13	2	40	4	0.8
B3	2	July 2 Aug 26	19	10	Oct. 13	2	20	3	0.3
B7	2	July 2 Aug 26	20	5	Oct. 13	2	40	4	0.8
C7	0	Check	0	5	Oct. 13	5	100	19	3.8
C8	0	Check	0	10	Oct. 13	9	90	31	3.1

TABLE VII - FULLER'S EARTH WASHES, BUSENBARK ORCHARD
Roseburg, 1920

Treatments					Results				
Row No.	No. of Applications	Dates of Applications	No. of Trees Treated	No. of Trees Wormed	Date Trees Wormed	Trees Infested No.	Trees Infested per cent	No. of Worms Total	No. of Worms Average per tree
B1	2	June 28 Aug 11	19	5	Oct. 24	1	20	3	0.6
B2	2	June 28 Aug 11	20	5	Oct. 24	1	20	1	0.2
B3	2	June 28 Aug 11	20	10	Oct. 23	1	10	1	0.1
B4	2	June 28 Aug 11	20	5	Oct. 24	1	20	2	0.4
B5	2	June 28 Aug 11	19	5	Oct. 24	2	40	3	0.6
B6	2	June 28 Aug 11	20	5	Oct. 24	4	80	12	2.4
B7	2	June 28 Aug 11	20	5	Oct. 24	3	60	10	2.0
C12	0	Check	0	10	Oct. 23	8	80	19	1.9
C17	0	Check	0	5	Oct. 24	4	80	17	3.4

An examination of tables VI and VII shows that the Fuller's Earth washes have some superiority over the lime washes. This superiority may be more pronounced in sections having considerable summer pre-

cipitation than it is in Oregon where there is very little rain during the summer months. Here again the washes containing naphthalene show up to best advantage, and have given a satisfactory control.

This uniformity of results from the use of the naphthalene washes is especially pleasing, and we believe warrants further tests of this material. We would be greatly interested in having other workers on this problem test the use of naphthalene as an active agent in washes for the control of either the Eastern or Western Root Borer.

PARASITISM AND NICOTINE IN THE CONTROL OF THE ORIENTAL PEACH MOTH: A SECOND REPORT

By LOUIS A. STEARNS, *Associate Entomologist, Virginia State Crop Pest Commission*

In respect to its distribution in Virginia, the status of the oriental peach moth, at the present time, remains unchanged. The Virginia infestation is still a well defined area within a few miles of Washington city. Here, however, there are indications of the increasing destructiveness of the species.

Collections have shown that within three years the numbers of the insect have been practically doubled. It has established itself with surprising rapidity in isolated plantings of young peach. That the pest has not spread by natural means to the important fruit-growing district of extreme northern Virginia is due possibly to a strip of forested and farming land some thirty miles in width intervening.

The lowest record, in 1920, of average infestation in small home-garden plantings of two-year old peach, based on twig counts, was 37 per cent, while in the case of individual trees, the injury ran as high as 81 per cent. In one instance, injury in a block of budded peach stock was found to exceed 85 per cent of all terminals.

A study made in an established orchard of the comparative growth of 600 uninfested and infested peach twigs of trees distributed among the varieties Belle, Bilyeu, Carmen, Elberta, Heath, Hiley, Salway and Smock produced interesting data. These trees, averaging eight years, had received a moderate winter pruning. The injury was due entirely to infestation by first brood larvae, at the time an average growth of 4.4 inches had been made. Contrary to the accepted idea, the major injury (83 per cent) was to lateral rather than to terminal growth from the year-old wood. Often, this injury was a gouging of

the fruit spurs, while the growth was still tender enough for feeding, and undersized, and in some instances, deformed fruits resulted. It was found, moreover, that fully 41 per cent of the first brood injured twigs grew no more during the season.

In 1920, the injury to late peach fruit was much greater than in preceding years. About mid-September, an examination made in an old infestation of considerable severity, by actual count of between 3000 and 4000 fruits on trees of the varieties Smock, Heath and Salway, showed infestations of 12, 43 and 58 per cent for these respective varieties.

These facts, and others of lesser importance, emphasize the necessity for, and warrant the publication of, increased knowledge concerning the control of the insect either by natural or artificial means.

Parasitism

In lack of an effective method of orchard control for the oriental peach moth, those who have published notes have commented hopefully on the fact, that this recently imported insect had become subject immediately to the attack of numerous parasites of our native species. Altogether, no less than nineteen hymenopterous and dipterous forms are known now to parasitize the peach moth in its egg, larva and pupa stages. The writer, in 1918, succeeded in rearing eleven species of parasites, the records of which have been published already.[1] Seven of these species had not been known to attack this insect. During 1919 and 1920, while continuing the study of the peach moth in northern Virginia, further attention was given to parasitism. The list of parasites reared each year has been much the same, the only new record being that of a single species of *Apanteles*[2] taken in 1920. However, in connection with from 1500 to 2000 orchard collected larvae, a number of interesting observations have been made.

Perhaps the most important fact is that parasitism is keeping pace with the increasing numbers of the host. It 1918, parasitism, while attaining and continuing at an average of 35 per cent for small numbers of larvae and pupae during the latter part of the summer, did not exceed 6 per cent in earlier collections. For all three summer broods in 1920, an average of 20 per cent parasitism was recorded, and the averages, 17, 16 and 25, for the first, second and third broods, respectively, show little variation. It has been encouraging, also, to find a uni-

[1]Jour. Eco. Ent., Vol. 12, No. 4, August, 1919, pp. 347-348.
[2]Kindly determined by Mr. S. A. Rohwer, U. S. National Museum.

formity in the extent of parasitism in collections made in the older infestations near the District of Columbia and those more recent and farther removed from the Potomac river.

Macrocentrus sp. has been at all times the most abundant parasite taken. In 1920, 132, or 92 per cent of the 143 specimens reared, were of this species. Apparently, it is becoming equally brooded with the peach moth, specimens emerging from the first brood between the dates June 24 and July 8, from the second brood between the dates July 24 and August 7 and from the third brood between the dates August 22, and September 21.

According to Rohwer[3] "the various species of *Macrocentrus* are internal parasites of microlepidoptera, and the overwintering habit will depend on the habits of the host. In most cases, they will overwinter in their cocoons as prepupal larvae."

Under normal conditions, the wintering, cocooned larvae of the peach moth include small numbers of the third brood, and the fourth brood in its entirety. A high degree of parasitism of the third brood affects indirectly, therefore, the number of wintering larvae and the size of the spring brood of moths, upon which the severity of twig infestation is subsequently dependent. However, up to the present time, no parasites of overwintering larvae have been reared, and it seems certain that *Macrocentrus*, and the other parasites as well, have failed to establish themselves as yet in this section of the seasonal life history of the peach moth, and that they still continue overwintering on their native hosts. It may be that this lack of parasitism of the fourth brood is due to its distinctly fruit-feeding habit, as compared with other broods, which may render oviposition by the parasites more difficult. Whatever the cause assigned, this fact, coupled with the low mortality of the insect for the dormant season (about 85 percent of the cocooned larvae have been found to overwinter successfully) accounts probably for its greater abundance in the orchard and the increasing destructiveness noted during the summer of 1920.

Laboratory Tests With Nicotine

Preliminary laboratory tests, involving 2877 eggs of the oriental peach moth, were conducted by the writer in 1919 to determine the ovicidal value of nicotine sulphate in respect to this species. The results were promising, and have been reported.[4]

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[3]Correspondence.

[4]Jour. Eco. Ent., Vol. 13, No. 4, August, 1920, pp. 364-367.

During the summer of 1920, these tests were continued, and on a sufficiently larger scale to give results that would eliminate the chance element present in tests in which only small numbers of eggs are employed. In this study, twenty-six experiments, comprising thirty-eight tests with eighteen insecticides and involving 9894 selected eggs were conducted at the Leesburg Field Laboratory. The results substantiate those obtained in the earlier tests. In addition, interesting data were secured on the relative toxicity of different strengths of nicotine sulphate, when used alone, and also, when used in combination with certain spreaders (caseinate and sea moss) and with an arsenical (powdered lead arsenate).

The method of procedure in these tests was similar to that described in the previous report. The eggs deposited on the foliage of one-year-old peach trees were always examined carefully with a hand lens, so that only well-rounded and apparently viable ones entered into the experiments. In applications, the atomizer was held at a sufficient distance to prevent any drenching of the leaves; only a spray mist hit them. Following applications, eggs were given daily binocular examinations up to hatching, and then, the young larvae were continued under observation for 36 hours.

Three series of tests were conducted, in all of which nicotine sulphate (40 per cent) was employed at the varying dilutions 1-1600, 1-800 and 1-500. In the first series, it was used alone; in the second series, a spreader was added; and in the third series, both an arsenical and a spreader were combined with it. Of the 9894 selected eggs, 4585 were sprayed, and 5309 were reserved as a check. Although an endeavor was made to distribute the eggs uniformly, a greater number were employed in those tests, in which applications were made at the more common 1-800 dilution of nicotine sulphate.

The efficiency, or killing power, of an insecticide is computed here, by deducting the per cent of check eggs not hatching from the percent of sprayed eggs not hatching, and in arsenical combinations, larvae dead 36 hours after hatching.

In the first series of tests, in which nicotine sulphate was used alone, 8.7, 70.3 and 80.5 per cent of the sprayed eggs did not hatch. At no time did more than 10 per cent of the check eggs fail to hatch. The actual percentages of efficiency for the varying dilutions 1-1600, 1-800 and 1-500 were 3.8, 60.4 and 73.5, respectively. The greater dilution gave practically no control, while the 1-800 dilution gave a little less than two-thirds, and the 1-500 dilution an approximately three-fourths control.

Either caseinate or sea moss, as spreaders, were added to the varying dilutions of nicotine sulphate, in the second series of tests. Caseinate, as referred to here, was in all cases powdered casein 1 part and hydrated lime 3 parts thoroughly mixed. The preparation of the sea moss spreader has been described previously. Caseinate was employed at the rate of 1 pound, and sea moss at the rate of 2 pounds, to 50 gallons of water. Inasmuch as there was no appreciable difference in the merits of these respective spreaders, the results are reported as one. The addition of a spreader influenced the effectiveness of the nicotine sulphate, especially in the case of the greater dilution. In the tests of this series, 44.4, 75.4 and 84.5 per cent of the sprayed eggs did not hatch, whereas, an average of 87 per cent of all check eggs were hatching, and in the case of the 1-500 dilution tests, only 4.7 per cent of the check eggs failed to hatch. This increased killing power due to the addition of a spreader is shown by the higher percentages of efficiency, 29.8, 61.4 and 79.7, as compared with the results in the first series of tests, in which nicotine sulphate was used alone.

Nicotine-arsenical combinations (nicotine sulphate at the same varying dilutions and powdered lead arsenate always at the rate of 1 pound to 50 gallons of water), with the addition of a spreader (employed as discussed in the preceding paragraph), constituted the third series of tests. Briefly, the combination of nicotine sulphate with an arsenical, in the hope of killing the young larvae immediately after hatching, did not give satisfactory results. The highest per cent of unhatched eggs in this series was 71.9 in the case of a 1-800 nicotine-lead arsenate-sea moss mixture, and in these tests, as high as 17.8 per cent of the check eggs failed to hatch. The highest percentage of efficiency, 54.1, was, therefore, considerably lower than that recorded in either the first or the second series of tests. Failure, here, is due probably to the commonly observed larval habit of rejecting the first few mouthfuls of food material, when entering twigs or fruit.

Extensive studies of the seasonal life history of the peach moth were conducted in connection with this experimental control work to determine the varying abundance of eggs present on the foliage during the egg-laying periods of the successive broods. The records of the deposition of 12678 eggs, in 1920, show that the dates for the heaviest deposits of eggs on the foliage in northern Virginia, as given in the previous report, are correct within seasonal variations. The dates of heaviest deposition, May 10 to 28 and June 27 to July 9, for the first and second broods, respectively, are quite distinct. The last two broods overlap to such a degree, however, that eggs are present on the foliage

from mid July until late September. The setting of a date for a single application against either the third or fourth brood eggs would be impossible, therefore.

The experimental studies, as reported here, are intended to form the basis of orchard spraying operations, during 1921.

SOME INSECT PROBLEMS CONFRONTING THE AVOCADO GROWER[1]

By G. F. MOZNETTE, *Assistant Entomologist, Tropical and Subtropical Fruit Insect Investigations, U. S. Department of Agriculture*

In the present day development of horticulture in the Tropics, there is no new fruit that is coming into prominence more rapidly or with greater assurance of becoming the basis of a profitable industry than the avocado, often erroneously called the "alligator pear." To many this fruit is still unknown, but its reputation is being more widely established each year. At the present time one may find avocados in many of the fresh-fruit markets in our northern and western cities and the fruit is fast becoming as well known as the grapefruit and pineapple. Its unique character reduces to a minimum its competition with other fruits, while its rich, nutlike flavor is almost universally enjoyed among those who have known it long enough to become familiar with its peculiar charm.

At the present time there are probably several thousand acres of bearing avocado groves in Florida and as many more acres in young groves coming into bearing. Avocado growing also is coming into prominence in southern California as well, where many choice varieties are being planted in orchards. Avocado growing in Florida, however, was established a number of years prior to its introduction into California, so that considerable more is known regarding the different phases of the industry in Florida.

With the growth of the avocado industry various problems have confronted the grower. Knowledge of the best methods of propagation, varieties and location best suited to culture to insure success are only successive steps in the production of a satisfactory crop of fruit. There are still other phases and one of the important ones in connection with successful avocado growing is the insect problem. Like citrus, the avocado is an evergreen and hence is subject to the continual attacks

[1]By permission of the Sec. of Agriculture.

of various insect pests, more so, than the decidous fruits growing in the temperate clime. The insects attacking the avocado in Florida are subject to varying changes of climatic conditions as faras their activities are concerned, which possibly would not attack the avocado growing in a more northern latitude as California. While some of the insects which attack the avocado in Florida may have been introduced, others may be insects which have always been present on native vegetation and have adapted themselves to the avocado as a host.

During the winter season in Florida, the avocado is dormant and the precipitation is greatly decreased from what it is during the summer. At this time of year various enemies attack the avocado which thrive under conditions of little rainfall and low humidity. One of the enemies which attacks the avocado at this time is the Avocado Red Spider (*Tetranychus yothersi*, McG.). In appearance this spider does not differ materially from the other species of *Tetranychus* which attack various other fruits. Unlike other red spiders, however, it confines its depredations to the upper surface of the foliage. Orchards heavily infested with red spiders appear in a short time as if scorched by fire. The foliage turns brown and frequently there is a heavy shedding as a result of their attacks.

Another enemy of this fruit during the winter is the so called greenhouse thrips of the north (*Heliothrips hemorrhoidalis* Bouche') which attacks the avocado in the open. Like the red spider it confines its work to the upper surface of the foliage. Besides producing the pale colored areas to the foliage which later assume a brown color and appear scorched, the foliage also becomes thickly covered with minute drops of blackish fluid voided by the thrips. Eventually the foliage drops prematurely as in the case of the red spider.

The loss generally sustained through an infestation of the red spider and leaf thrips, results in injury to the starch laden foliage of the avocado during the winter. By premature defoliation a set back usually results to the trees the following spring in their activities to set a full crop of fruit. The over wintering foliage should remain on the trees for some time after the blossoming period when new foliage is produced to take its place.

These two pests can be controlled effectively on the avocado by spraying with liquid lime sulphur 1 to 50 with the addition of nicotine sulphate 40% at the rate of 1 to 900 to the diluted lime sulphur without injury. The powdered lime sulphur has been found to work satisfactorily using 2 pounds to 50 gallons of water incorporating the nicotine sulphate 40% as is used in connection with the liquid lime sulphur solution.[c]

With the approach of spring, various other insect activities appear. Before the avocado tree produces new foliage, the blossom clusters arise from the terminal twigs or from the base of the years' growth The bloom as it appears is attacked by a blossom thrips (*Frankliniella cephalicus* Craw.). This blossom thrips is not the same which attacks citrus in Florida or California. However, it does not differ materially in general appearance from most thrips. It averages about a millimeter in length and in general color is pale yellow. It was first recorded as taken from native acacia-like plants in the mountains of Mexico and it is quite probable that it has found its way into Florida from that country. The injury produced by this thrips is caused by feeding of the young and adults on the individual flower parts. As succeeding generations appear the adults deposit their eggs in great numbers in the stems and pedicles which bear the floral panicles and which eventually hold the fruits as they set to the terminal twigs. The species does not attack the fruit.

It is controlled by spraying with nicotine sulphate 40% solution 1 to 900 with the addition of 2 or 3 pounds of soap added to each 100 gallons of the diluted spray as a spreader.

With the maturing of the bloom and the setting of the fruit, new foliage commences to arise from the floral racemes. As the new growth appears it is attacked by the avocado white fly (*Trialeurodes floridensis* Q.). This white fly is unlike any species which attacks citrus in Florida and California. The adults are small and average less than a millimeter in length and possess pale yellow bodies. The adults which appear at this time emerge from the pupae clustered in great numbers on the lower surface of the older dormant foliage. The adults deposit their eggs in great numbers on the new growth, the larvae which hatch from the eggs pass their existence on the lower surface of the foliage. As the new growth commences to harden, pupae are formed and the adults which emerge later reinfest subsequent new growth put out by the trees. There are three generations with a partial fourth in southern Florida during spring and summer. This species like practically all species of white flies produces an abundance of honeydew in the course of development. This honeydew accumulates on the upper surface of the foliage and fruit. The sooty mold fungus develops in this honeydew deposit eventually giving the avocado foliage and fruit a decided dirty and blackened appearance. The sooty mold adheres rather tightly to the fruit which must be cleaned before shipment, necessitating considerable extra labor. By proper spraying this expense is practically eliminated.

The pest is controlled by spraying with the regular oil emulsion sprays. Two sprayings generally are necessary, one during the spring at a strength of 1 to 80 and another in the fall at 1 to 70.

A question of considerable importance arises in connection with spraying with oil emulsions in southern Florida. The waters which are generally used for spraying purposes come from wells situated in limestone formation and are termed "hard". They generally contain bi-carbonate salts and when combined with oil emulsion sprays at times separation occurs, with the result that free oil is produced which is detrimental to avocado foliage. Softening of the water is necessary when using an oil emulsion which otherwise separates when combined with such water. Recently the oil emulsions are being perfected by the incorporation of organic stabilizers in their manufacture which prevents separation to a marked degree.

At times various scale insects give the avocado grower considerable trouble. One in particular is the Dictyospermum scale (*Chrysomphalus dictyospermum* Morgan), which makes inroads into the tree, attacking the twigs, branches and where numerous, the foliage. Its effect on the avocado is very similar to that produced by the San Jose scale on various deciduous fruits.

Another scale which seriously attacks the avocado is the Pyriform scale (*Protopulvinaria pyriformis* Ckll.). This scale attacks the young foliage in the spring, the immature scales migrating as they hatch from the mature scales on the older foliage. In the process of development of this scale honeydew is produced in practically the same manner as when white flies are present, eventually giving the fruit and tree a decided dirty blackened appearance. The Dictyospermum scale and the Pyriform scale are controlled by spraying with oil emulsion sprays during the dormant season of the year at a strength of 1 to 70.

Various other insects which attack the avocado may cause serious damage at times are: the blossom anomala (*Anomala undulata* Mels.); the avocado tingid (*Acysta perseae* Heid.); the avocado leaf hopper (*Empoasca minuenda* Ball); the cocoanut mealy bug, (*Pseudococcus nipae* Mask.); the black scale (*Saissetia oleae* Ber.); the avocado leaf roller (*Gracilaria perseae* Busck); and the cotton stainer (*Dysdercus suturellus* H. Schf.).

SOME NOTES ON A NEW AND PROMISING INSECTICIDE[1]

By ERNEST N. CORY, *College Park, Md.*

Routine tests of a new insecticide about to be put on the market by McCormick & Company, Baltimore, Maryland, developed the fact that the material has considerable promise, particularly, in certain fields.

The insecticide is an alcoholic extract of pyrethrum prepared in the form of a heavy liquid soap. It mixes readily with water at any desired strength, spreads evenly and sticks fairly well.

Tests were conducted to determine its efficiency as a contact spray, as a repellent and as a stomach poison. Whether the efficiency could be increased by the addition of more soap was tested and the effect of the spray on foliage and flowers was carefully noted.

The following insects were used: the egg plant lace bug (*Gargaphia solanii* Heid.); two species of rose slugs (*Cladius pectinicornis* Fourer and *Endelomyia rosae* Harr.); the mealy bug (*Pseudococcus citri* Risso.); plant lice on nasturtium (*Aphis rumicis* Linn.); the chrysanthemum aphis (*Macrosiphum sanborni* Gill.); an undetermined aphid on Japanese Barberry, the eggs of the imported cabbage worm (*Pontia rapae* Linn.); the imported currant worm (*Pteronus ribesii* Scop.); and the tent caterpillar (*Malacosoma americana* Fabr.).

TESTS AS A CONTACT INSECTICIDE

Tests against the egg plant lace bug in the field were inconclusive, therefore, further tests were made on large pieces of infested plants placed in water in the green-house. These plants were sprayed Oct. 5th with a dilution of 1 to 300. After 24 hours 50% were dead and the balance showed feeble movements. Most of the latter had left the plant and were lying feet upwards on the floor of the cage. All finally died after a lapse of 48 hours.

Rose aphids on the tips of roses in the green-house were sprayed Oct. 1st. and March 12th. The first application was made at a dilu-

[1]Contribution from the Entomological Laboratory - Maryland Agricultural Experiment Station. December 20, 1920.

tion of 1 to 100 with a 95% mortality resulting. On March 12th the material at a dilution of 1 to 300 was sprayed and counts showed 650 dead aphids on the sprayed twigs, representing 100% mortality. The check selected, having 200 aphids on it, showed only 9 dead at the time the counts were made on the sprayed bushes.

The bean aphis on nasturtium was sprayed Oct. 5th with a dilution of 1 to 100 resulting in 100% mortality.

On Oct. 6th potted chrysanthemums badly infested with the brown aphis were sprayed with dilutions of 1-100, 1-300 and 1-500 prepared just prior to spraying and 1-300 that had been diluted five days. Examination Oct. 7th showed one live wingless aphid on the plant sprayed with a dilution of 1 to 300, (freshly prepared), and one live winged aphid on the plants sprayed with 1 to 300 (prepared five days). On Oct. 13th three chrysanthemum plants badly infested with brown aphis were sprayed with 1-1000, 1-1500 and 1-2000. Notes made Oct. 14th and 16th disclosed almost complete control. These tests were repeated Nov. 10th on mums in bloom using 1-800 and 1-1000 that had been made up one week from a new lot of the insecticide and 1-2000 that had been made up on Oct. 14th from the original sample. The former application did not control the aphids while the 1-2000 gave complete control. Later it was learned that the second sample was only one-half the strength of the first sample so that for comparative purposes the above solutions would represent dilutions of 1-1600 and 1-2000. Just what factor caused the decided difference, cannot be stated. On May 15th, 1920, Japanese barberry bushes heavily infested with aphids were sprayed at the rate of 1-600. Nearly complete control was obtained in this case.

A very insufficient test of the effect on the eggs of the imported cabbage worm is herewith given for what it is worth. Three lots were sprayed respectively with strengths of 1-100, 1-300 and 1-500. Two lots of two eggs each were retained as checks. One egg in each lot of checks hatched on the 11th of October while none of the sprayed eggs hatched. Mealy bugs on coleus were sprayed with a dilution of 1-100 October 1st with no perceptible beneficial results. On the red spider the results were likewise unsatisfactory.

Field tests on full grown tent caterpillars at a dilution of 1-600 gave 100% control. Laboratory tests at various dilutions from 1-100 to 1-600 gave complete control in all cases, though the time necessary to kill depended upon the strength of the solution and the size of the larvae.

Rose bushes thoroughly infested with the Bristly Rose Slug in the green-house were sprayed with a dilution of 1-100. All slugs were

killed. The native rose slug was sprayed out doors on May 18th with a dilution of 1-600 with practically 100% control. Almost full grown larvae of the currant worm were sprayed in the laboratory on May 19th with dilutions of 1-500, 1-600, 1-700, 1-800, 1-900 and 1-1000. Tak-a-nap soap was used with similar dilutions at the rate of 4 pounds to 50 gallons. Fourteen lots of 10 larvae were sprayed resulting in an average of 66% killed. Very little difference between the weaker and stronger solutions with or without soap prevailed.

Tests As A Stomach Poison And As A Repellent

The work with the tent caterpillars gave us notes on its effect as a stomach poison and as a repellent. In the laboratory tests with the tent caterpillars, leaves of the wild choke cherry were dipped or sprayed in dilutions ranging from 1-100 to 1-200, allowed to dry from 2 to 4 hours and then placed in vials of water under lantern globe cages or small screen inclosures. Ten larvae were then introduced in eaeh cage; 25 test lots and 5 check lots. In all cases the larvae refused at first to stay on the treated leaves. There was a shrinking of the body and an inactivity on the part of the larvae resulting from confinement with the leaves. Approximately 50% died after a lapse of 5 to 10 days. This indicates a decided repellent and possible toxic action. In one of the large cages though there was plenty of circulation of air, a number of dead and dying larvae were found on the bottom of the cage after they had fed upon the sprayed leaves. In many of the smaller cages, the larvae refused to feed and it is possible that the fumes were the cause of the disinclination to feed. From these experiments we were unable to determine whether the material acted as a stomach poison or a contact insecticide, partly due to the type of cage used, the general inactivity of the larvae and the fact that little eating was done even by those in the check cages, in one set of experiments.

Summary

Tests indicate that the material has a decided effect as a contact insecticide, repelling powers to a considerable degree and a possible toxic action.

In no instance did the material injure the foliage or spot the most delicate flowers.

The field for the use of this material in green-houses, on flowers and ornamentals and in home gardens seems to be promising. Its application to the control of insects affecting forage, that cannot be sprayed with an arsenical, offers another possibility.

BIOLOGICAL CONTROL OF THE BLACK SCALE (*Saissetia oleae*) Bern. IN CALIFORNIA

By HARRY SCOTT SMITH, *Chief, Pest Control Service, California Department of Agriculture*

For many years the black scale, *Saissetia oleae* Bern., has held the foremost place as a pest both of citrus fruits and olives in California. It is wide-spread in its distribution and capable of serious injury to either fruit. In fact it would be an impossibility in most parts of the state to grow either citrus fruits or olives without carrying on control measures against this pest. Los Angeles County alone spent $850,000 during the season of 1919 for fumigation of citrus trees, most of which was directed against the black scale, and the total sum expended for this purpose in California exceeds two millions of dollars per annum. This does not take into consideration the expense of washing the fruit, necessitated by the secretion of honey dew, or the reduction in quality or quantity of fruit due to the infestation.

Obviously, in the face of such a staggering tax on production, there is a strong incentive to students of the problem to seek a reduction in the cost of suppression. Biological control has seemed to hold such a possibility.

Following the successful outcome of the biological control work against the citrus mealybug, a study of the applicability of this method to black scale control has been taken up. This method is based on the proposition that, given a host insect of certain type, which is normally attacked by an effective sequence of parasites, fluctuation in numbers between host and natural enemies can be prevented by the continued artificial propagation and liberation of the natural enemies in the infested orchards. The writer has previously pointed out[1] that success with this method is dependent upon certain factors, among which were "Sequence of available entomophagous insects" and "Possibility of rearing or obtaining the entomophagous insects in sufficient quantities." Until recently there was not available for the black scale in California a satisfactory sequence of natural enemies, there being no effective parasite of the intermediate stages of the host in our fauna. *Rhizobius ventralis*, the ladybird introduced by Koebele from Australia, was of considerable importance as a predator on the young scale,

[1]Jour. Econ. Ent. Vol. 12, 1919, p. 288.

and *Scutellista cyanea*, a parasite which feeds on the eggs beneath the parent scale, at times did good work. The introduction into California in 1919 of *Aphycus lounsburyi* How., an effective internal parasite of the immature stages of the scale, fills a conspicuous gap and completes the sequence. At about the same time the writer demonstrated that black scale, like mealybugs, could be grown under laboratory conditions on potato sprouts, so that during the summer of 1919 conditions seemed to warrant an attempt to bring about a control of the pest by the biological method.

Accordingly, in September, 1919, a second insectary was established at Alhambra for the purpose of propagating and distributing natural enemies of the black scale, and two plots of trees selected for the purpose of demonstration, one at Alhambra and the other at Santa Paula, Ventura County, on the Limoneira ranch, where the management had volunteered to maintain an insectary under supervision of the State Department of Agriculture. A block of 54 infested trees on the Limoneira ranch was set aside, unfumigated, for this work. *Aphycus lounsburyi* was colonized on these trees, began breeding with rapidity, and by May of the following year had rendered them commercially free of scale. The Limoneira company were so encouraged by this demonstration that they then set aside a block of 10,000 infested trees. The same performance was repeated, together with colonizatons of *Rhizobius ventralis* and *Scutellista cyanea*, and at the present writing 75% of the scale have been destroyed and there is no doubt but that by spring this orchard, too, will be commercially clean. The *Aphycus* particularly has done wonderful work, the adults literally swarming on the trees on warm sunny days.

It was soon found, however, that while the biological control was apparently a simple matter under certain conditions, under others it was a more difficult problem. At Santa Paula and various other citrus districts along the sea coast, the black scale has an uneven hatch, that is to say, almost any stage of scale may be found at almost any season, although many entomologists insist that there is only a single generation. On the other hand, in the interior districts, the hatch is very even, the scale being largely of one stage at any given time. This has a very important bearing on the propagation of *Aphycus lounsburyi*, the most effective natural enemy, in the orchards. *Aphycus*, breeding on certain stages only, is unable to maintain itself in numbers in those localities where, for a period of several months, those stages of the scale favorable to its development are not present or are very scarce in the orchards. On the other hand, in districts where the scale has

an uneven hatch the parasite breeds uninterruptedly throughout the year and, having many generations to one of the host, is soon able to overcome it.

The work has already progressed to a point where it is safe to conclude that it will be of immense practical value in the control of the black scale, since there are extensive areas where scale conditions are conducive to the uninterrupted breeding of *Aphycus lounsburyi*. Even in the interior, where the problem is more difficult on account of the even hatch, there is reason for optimism, because the problem there is simply a question of quantity production of natural enemies in insectaries with which to restock the orchards occasionally. Sufficient progress has been made on this phase of the work to justify the belief that it can be worked out to a successful conclusion. The most serious obstacle to success in some districts is the presence on the trees of other species of scales which are not destroyed by the enemies of the black scale and which consequently require fumigation. It is hoped that this obstacle may be overcome in part by resorting to spraying, which is much cheaper than fumigation, and by the propagation and distribution of the natural enemies of these other scales, a study of which is already under way.

An interesting development in this project, both from a biological and economic standpoint, is the enormous increase of secondary parasites since the introduction of *Aphycus*. Two species particularly, *Quaylea whittieri* Timberlake and an undescribed species of *Eusemion*, the former normally a secondary on *Scutellista* and other parasites, the latter a secondary on parasites of *Coccus hesperidum*, have increased to enormous numbers in the orchards where *Aphycus* has been established. Just what effect they will have on the practical outcome of the work is of course problematical.

THE JAPANESE BEETLE QUARANTINE[1]

By C. W. Stockwell, *Riverton, N. J.*

From observations and results accomplished by the quarantine regulations in force against the Japanese beetle for the past two years it seemed advisable to continue this quarantine work, in an endeavor to hold the beetle in check and prevent if possible its widespread distribution over the United States until some adequate means of control might be found.

[1]Published by permission of the Secretary of Agriculture.

As a result of scouting operations during the past summer, beetles have been located in considerable numbers throughout a strip of territory about eight miles in length and some over a mile wide in Pennsylvania along the Deleware River, directly opposite the infested territory in New Jersey. This infestation has necessitated the placing of a State quarantine by Pennsylvania to supplement the Federal and State of New Jersey quarantine orders in force since June 1, 1919. The two state quarantines are identical with that of the United States Department of Agriculture, except that they prohibit without certification the intra-state and the Federal inter-state movement of the articles quarantined.

Previous to April 1, 1920, green or sugar corn was the only article of which shipment was restricted, but at that time regulations became effective to prohibit without certification the transportation from the quarantined area of nursery, ornamental and greenhouse stock including bulbs, throughout the year, and from June 15 to November 1, farm and garden produce of all kinds, as well as flowers in any form.

This insect was first discovered in August 1916 in the vicinity of Riverton, N. J., and since that date has spread over an area of approximately 85 square miles, 75 of which are in New Jersey and the remainder in Pennsylvania. The area in New Jersey is mainly a market garden and fruit growing section with Philadelphia as its chief market, while that in Pennsylvania is largely a residential section with much less of it given up to farming. A considerable number of greenhouses and nurseries fall within this infested area; some of whom handle only cut flowers, while others have a varied line of plants, bulbs and outdoor grown stock.

The present requirements of all greenhouses shipping potted or unpotted plants are as follows: Potted plants must be potted in soil free from grubs, the soil to be considered as such only when sterilized or obtained a reasonable distance outside the known infested area. After potting, these plants must be kept free from infestation. The roots of unpotted plants must be washed free from soil and in the case of ornamentals requiring earth about the roots an inspection is made of the soil about the roots as the tree is dug, also the nursery blocks must be kept in a clean state of cultivation throughout the season of beetle activity and no beetles found in the immediate vicinity. During the past season every attempt has been made to keep greenhouse and nursery surroundings free from attractive food plants and considerable spraying has been done with repellents in an attempt to make

conditions unattractive to the beetles, therefore eliminating if possible the chances of their infesting the immediate surroundings of nurseries and greenhouses.

Regarding the matter of farm and garden produce, as said before these are restricted only from June 15 to November 1, and during that period certification is required of all farm produce passing out of the quarantined area. Farms within the quarantined district but outside the actually infested section are given blanket permits, good until conditions warrant inspection of their produce. Throughout the past season hay was forbidden shipment altogether from the infested zone, as it is impossible to certify a quantity of hay and say that it is free from infestation. All sweet or sugar corn carried out was inspected, this crop is the most likely of any garden produce to harbor beetles inasmuch as the beetles are attracted to it and work their way beneath the husks at the silk end. This past summer, 2,137 baskets of corn were examined and 846 beetles found, a considerable amount of this corn was shipped to points as distant as New York and Pittsburgh. Smooth skinned crops such as apples, pears, peas, melons and tomatoes are very unlikely to be infested if properly handled and graded. One of the principal endeavors has been to get the farmers to take their produce in from the fields as soon as possible after gathering and then generally to regrade or sort under cover, thereby lessening to a decided degree, the possibilities of the beetles clinging to the different articles.

In the case of flowers gathered by individuals and carried from place to place, it is almost impossible to stop this without posting inspectors upon every road leading out of the area also upon every train or trolley passing out. In order to warn people unfamiliar with the requirements, cloth signs were stretched across all principal roads leading out of the infested area, stating that it was unlawful to carry beyond that point, garden and farm produce, flowers, etc., without certification by our office. It is difficult to say just how helpful these signs were but we believe they caused many to hesitate and procure a permit before carrying prohibited articles out of the restricted territory.

The increased area over which the quarantine is in force at the present time will require a somewhat different method of procedure than that in force throughout the past season but from the experience of the past two years adequate plans are being worked out and put into execution to cover this enlarged area.

IMPORTANT INSECTS COLLECTED ON IMPORTED NURSERY STOCK IN 1920

By E. R. SASSCER, *Washington, D. C.*

During the fiscal year 1920, 11,081,756 plants, not including bulbs and seeds, were offered for entry into the United States from the five principal exporting countries of Europe, which were distributed as follows: England, 1,041,700; France, 9,334,645; Holland, 705,411; Belgium, 1; Germany, 1.[1] The total number of foreign plants offered for entry was 11,423,821, showing a decrease of 5,412,459 as compared with the previous fiscal year. This reduction of foreign plants entering the United States has not, however, resulted in a corresponding decrease in the number of injurious insects arriving on nursery stock; but to the contrary, the list of interceptions, which comprises some well known pests, includes more insects than any year hitherto. Inasmuch as a complete list of the insects and diseases intercepted on foreign plants from October 1919 to December 31, 1920 will be prepared in the near future, it is proposed to confine this paper to insects which are known to be injurious.

The Brown Tail Moth was intercepted on eleven occasions on fruit seedlings and stocks from France; and the Sorrel Cutworm (*Acronycta rumicis* L.) was found in one shipment of Mahaleb stock from the same country. Rose stocks from Holland, Scotland, Ireland, England, and France were infested with *Emphytus cinctus* L., and several shipments of bulbs from France and Holland were infested with *Eumerus strigatus* Fallen. and *Merodon equestris* Fabr. One shipment of French Paradise Apple stock was found exhibiting an infestation of the White Tree Pierid (*Aporia crataegi* L.), and a shipment of Rosa rugosa from Holland was found to contain specimens of *Cacoecia podana* Scopoli, which is a general feeder, and not known to occur in the United States.

The Pink Bollworm (*Pectinophora gossypiella* Saunders) was intercepted in cotton seed from China and Japan, and in seed attached to burlap arriving from Egypt and Holland. It has also been intercept-

[1]The number of plants entered from these countries from 1913 to 1919 inclusive will be found in previous reports under the same title published annually in the JOURNAL OF ECONOMIC ENTOMOLOGY.

ed on several occasions on the Mexican Border, having been found in cotton seed and cotton bolls, in suitcases of passengers, and in pillows and quilts. These interceptions were especially fortunate, since the infested seed was in the possession of immigrants enroute to cotton fields where they were to be employed as laborers. Numerous interceptions were made at the port of New York, the most important of which perhaps, was the finding of living larvae of the European Corn Borer (*Pyrausta nubilalis* Hubn.) in a large shipment of Italian broom corn.

A wire worm (*Agriotes lineatus* Fab.) not known to occur in this country, and considered very injurious to cereal crops in Europe, was collected in a shipment of Danish potatoes; and the Potato Tuber Moth (*Phthorimaea operculella* Zeller) was taken on Irish potatoes from Australia Chili, Peru, and Spain. The Sweet Potato Weevil (*Cylas formicarius* Fab.) was taken in shipments of sweet potatoes arriving from Nassau, Cuba, Mexico, Jamaica, Isle of Pines, and Porto Rico; and the West Indian Sweet Potato Weevil (*Euscepes batatae* Waterhouse) arrived in tubers from Porto Rico. Yams from Jamaica and Cuba were found to contain larvae of *Palaeopus dioscoreae* Pierce and *P. costicollis* Marshall respectively. The black fly of citrus (*Aleurocanthus woglumi* Ashby) was collected on the foliage of the following fruit trees arriving from Cuba at Florida ports of entry: grapefruit, lime, mango, sapodilla; and *Aleurothrixus howardi* (Quaint.) was collected on the foliage of grapefruit from Cuba and the Isle of Pines.

Living larvae of *Anastrepha fraterculus* Weid were collected in guavas, mangoes, Cuban plums, and Sapodillas from Cuba, and what appeared to be the larvae of *A. striata* Schiner were found in guavas from the same country. Mangoes from Spanish Honduras were found to contain larvae of an unrecognized species of Anastrepha. Three insects, representing as many genera injurious to avocadoes were intercepted; viz., *Heilipus persea* Barber, from the Canal Zone; *Stenoma catenifer* Walsh, from Spanish Honduras; and what appears to be *Conotrachelus persea* Barber from Costa Rica and Mexico. The last named insect was found quite abundant in avocadoes for sale in the markets of Nuevo, Laredo, and Piedras Negras during the months of May and June. *Metamasius sericeus carbonarius* Chev. was collected on several occasions in shipments of bananas arriving from Guatemala and Spanish Honduras. In addition to the above some eighty distinct species of scale insects were found on plants offered for entry, many of which are not at present established in this country.

Insects in Soil

During the past year, several shipments of plants arrived containing soil about the roots in violation of Quarantine 37 which provides that such plants shall be "free from sand, soil, or earth." Four such shipments were found to contain injurious insects. Larvae of a species of Agriotes were contained in soil surrounding the roots of a Sunstar rose from Ireland, and what appears to be an injurious curculionid larva was found in soil around a Japanese iris from France and soil around Stilbe roots from Holland. Evergreen shrubs from Holland were found to contain the European Earwig (*Forficula auricularia* L.), and herbaceous ornamental plants from the same country contained in the soil surrounding the roots, *Otiorhyncus sulcatus* Fab.

Perhaps the most important soil interception was the finding of *Leucotermes tenuis* Hagen in soil around plants arriving from Brazil. This termite is considered the most destructive species in the world, and has been found in Santo Domingo, the Bahama Islands and Brazil. It is reported that this termite was introduced into the island of Saint Helena and was so destructive at Jamestown, the capitol, that new buildings had to be erected.

THE EUROPEAN RED MITE (*Paratetranychus pilosus* Can. & Fanz.) IN CONNECTICUT

By Philip Garman, Ph.D.

A mite which seems to be *P. pilosus* Can. & Fanz. appeared last summer in destructive numbers in Connecticut orchards. It was noticed on leaves brought from the field at Milford April 25, by M. P. Zappe, but the first signs of injury were noted by Doctor Britton at Milford about July 2. At this time several trees in an orchard showed a premature rusty appearance, and the leaves were found to be inhabited by many mites. Later a much larger orchard was reported to be infested, and during the summer it was found in four additional localities.

Difference From Other Economic Species

As the name above suggests, the mite is usually red in color, thus contrasting with the ordinary *T. bimaculatus* which is more often greenish or yellowish. The setae of the dorsum are large, arise from tuber-

cles and are pilose. The egg is usually more or less flattened above and striate, being thus different from the glistening spherical egg of *T. bimaculatus*. There may also be seen a short erect column arising from the upper surface which is usually about equal in length to the diameter of the egg. The tarsi are provided with long hook-like claws, which are lacking in *bimaculatus*. Other microscopical features are also shown in Fig. 7, 1-10.

The mite is still more unlike the clover mite, *Bryobia pratensis*, since the latter is much larger, dark bluish or purple in color when adult and is provided with a number of plates around the margin of the body. The egg of the clover mite is also larger than the red mite, being .19mm. in diameter instead of .15; and does not possess the central stalk.

Occurrence in Connecticut and Elsewhere

This is the first record of the appearance of the mite in Connecticut but it was noticed in Pennsylvania in 1919,[1] by Caesar[2] in Ontario in 1915, and has been studied extensively in Sweden by Trägardh[3] in 1915. It was originally described from Italy in 1877-8 and probably has a much wider distribution than indicated here.

In Connecticut it has been found in New Haven, North Haven, Branford, Milford, Meriden, Middletown, Greenwich and Danbury.

Common Names Used for the Mite

Trägardh calls it the fruit-tree spinning mite, Caesar the European plum mite, while in Italy it is known as the rose mite. The name used in this paper is merely a descriptive title and should not be followed unless passed upon by the nomenclature committee of this society.

Nature of Injury to Host

Thus far it has been taken in Connecticut on apple, cherry and rose, but has not been collected from plum. On apple the most noticeable effect of the infestation is a browning of the foliage, but some trees assume a dull leaden appearance. Late in summer the trees lose a good many leaves, and the size of the fruit appears to be affected. Thus

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[1]Journ. Ec. Ent., 12: 407-8: 1919.
[2]Can. Ent., xlvii: 57-58: 1915.
[3]Rev. Appl. Ent., IIIA: 254: 1915 (Abstract).

in several selected Baldwin trees, 19-24% of the fruit was 2¼ inches in diameter (the remaining 76-81% being smaller) while in uninjured trees of the same age in the same neighborhood, 44-60% of the fruit attained this size. One tree observed the latter part of September had hardly any fruit fit to sell.

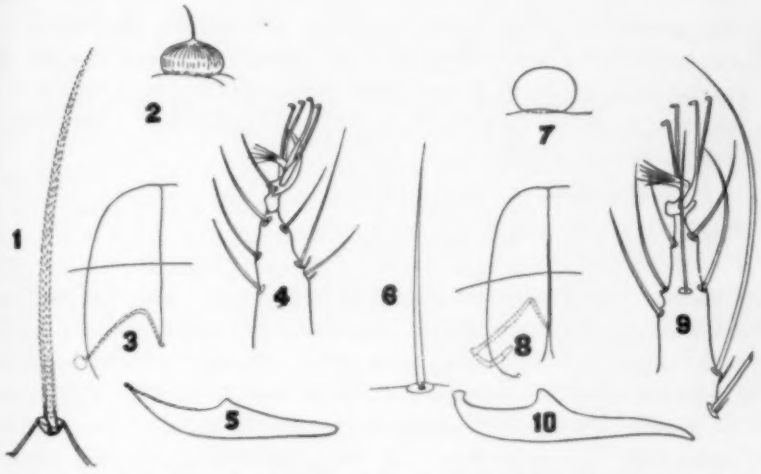

Figure 7. Structures of European red mite *Paratetranychus pilosus* Can. and Fanz. and common red spider *Tetranychus bimaculatus* Harvey.

1 *Paratetranychus pilosus*, seta of dorsum 846 times enlarged; 2, egg, 14 times enlarged; 3, collar trachea and mandibular plate, 714 times enlarged; 4, tarsus of first pair of legs of female, 921 times enlarged; 5, penis, 1400 times enlarged.

6, *Tetranychus bimaculatus*, seta of dorsum, 846 times enlarged; 7, egg, 14 times enlarged; 8, collar trachea and mandibular plate, 714 times enlarged; 9, tarsus of first pair of legs of female, 921 times enlarged; 10, penis, 1400 times enlarged.

Baldwins are more easily injured than other varieties, but some browning was noted on McIntosh, Hurlburt and Ben Davis. Greening is resistant and although infested did not show the effects of the infestation.

How Long Has It Been in Connecticut?

In order to become so widely distributed, the pest must have been present in the State for some time. Mites reared from eggs obtained in 1919 appear to be the same species as those obtained later. In looking over our slide collection, a single slide was found containing mites from apple leaves, collected by Mr. Zappe at Clintonville, a point near

New Haven. This slide, made in 1917, contains the same species. It has therefore been present in the State for three years and possibly longer.

Means of Dispersal

Apples examined in the field frequently showed an abundance of small red eggs placed well within the calyx cavity. Probably they are thus carried from place to place on the fruit, and under favorable circumstances may hatch and regain a host. There is also considerable local distribution by winds.

Possibilities of Control

Our limited experience in controlling this mite under Connecticut conditions indicates that possibly the commercial lime sulphur (1-9[1]) applied as a late dormant spray may prove effective. Certainly none of the summer treatments applied July 28, in one orchard where four different combinations were used, gave results that would warrant such treatment by the grower. In this laboratory, laundry soap, 4 lbs. in 50 gals. of water, killed nearly all of the mites with which it came in contact; but before we understand how to control this pest much more work must be done, especially in the line of field tests and observations under local conditions.

Blister Beetle Injury to Peaches. Blister beetles, identified as *Pomphopoea aenea* Say, caused considerable injury in a peach orchard at Marshallville, Georgia on March 10th. The trees were in full bloom on that date and the beetles attacked the blossoms, eating through the calyx and then devouring the pistil. Very often the young foliage just putting out was eaten. An army of these beetles had destroyed all blossoms on about fifty trees in a 4000-tree orchard before they were observed. Hand picking was advised immediately and with the assistance of an application of arsenate of lead, and early morning jarring the outbreak was checked within twelve hours.

Oliver I. Snapp, *Entomologist*,
U. S. Entomological Laboratory,
Fort Valley, Georgia

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[1]Since writing the above it has been found that miscible oils like scalecide are very effective ovicides.

NOTES ON THE LIFE HISTORY AND THE CONTROL METHODS OF THE BOX WOOD LEAF MIDGE, (*Monarthropalpus buxi Labou.*)[1]

By C. C. HAMILTON, *College Park, Md.*

The Box Wood Leaf Midge is a small, frail, yellow Cecidomyid, the immature stages of which are found in the leaves of box wood plants. Here it causes characteristic gall-like swellings (pl. 4, fig. 3) and in cases of severe infestations the dropping of the leaves, results in a ragged and unsightly bush or hedge. This pest was apparently introduced from France or Holland in imported box wood plants. Felt in 1910 records its first appearance in the United States at Kingston, R. I. Since then it has been reported from a number of states along the Atlantic coast and from California.

It is the purpose of this paper to give a summary of the most important phases in the life history of the insect and some of the more promising methods for controlling it.

LIFE HISTORY AND BIOLOGY

In the vicinity of Baltimore, Maryland, the insect passes the winter as a partly grown larva, molting at least once in the spring before pupating. Pupation commences about the first of May and continues until the latter part of the month, the majority of the larvae pupating from the 8th to the 12th. The pupal stage lasts from two to three weeks with an average of sixteen or seventeen days. When ready to emerge the pupa pushes its way through the lower surface of the leaf until all but the last five or six abdominal segments are out. It then crowds the body forward in the pupal skin until the skin splits along the dorso median line of the thorax. From five to ten minutes are required for the adult to emerge from the pupal skin with an additional two to five minutes before the wings have expanded and the adult is able to fly away. It is in this period, from the breaking of the leaf

[1]Contribution from the Entomological Laboratory Maryland Agricultural Experiment Station - December 20, 1920.

until the adult has emerged and is able to fly, that the insect can be most easily controlled. At Baltimore the first adults emerged on the 19th of May and the last adults noticed were flying on the 2nd of June The maximum emergence occurred May 26th.

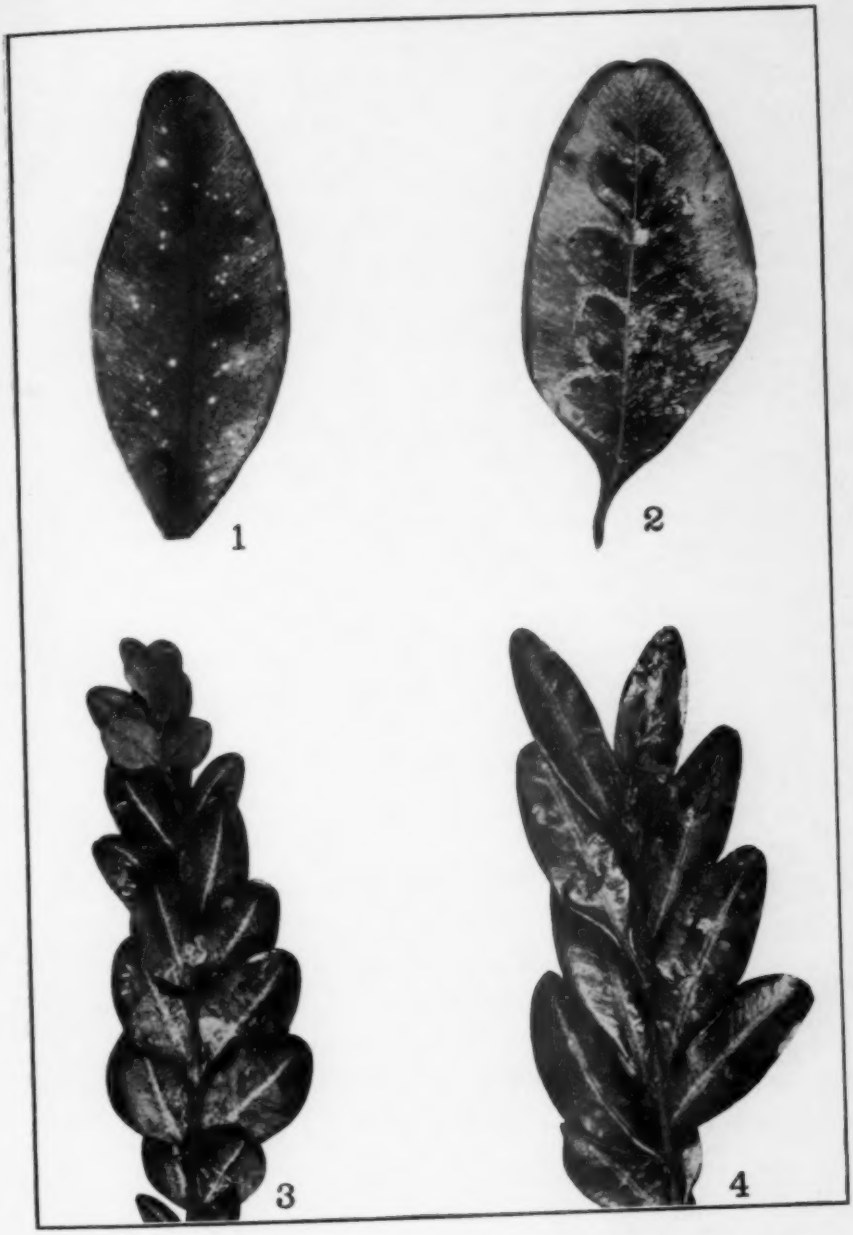
The eggs are inserted by the female from the underside of new leaves by means of the curved, pointed and needle-like ovipositor which slits the ventral surface. The ovipositor apparently stretches the tissues of the leaf and permits the egg to be forced through as no slit in the leaf surface could be found shortly after the eggs were laid. The time required for the deposition of a single egg varied from three to eight minutes, with an average of five and one-half minutes. In a number of cases females were observed to lay four and five eggs in succession in the same leaf.

In the box wood hedge at Baltimore, egg laying was first observed on May 20th, with the maximum occuring on the 26th. In the laboratory 25 adults, 9 males and 16 females, emerging at 10.00 P. M. May 26th were placed in a lantern globe cage with fresh leaves. Mating was observed early the next morning and by noon the females had begun to lay eggs, and continued until evening. No mating or egg laying was observed after the 27th. The first adult, a male, was dead the the morning of May 27th and the last adult died the evening of May 30th. Two hundred and ninety eggs were laid in the leaves, or an average of eighteen for each of the sixteen females. All of the females had eggs remaining in the ovaries when they died. A count of the eggs in the ovaries of newly emerged females gave an average of fifty-four for each adult.

The egg is white to transparent, oval and averages .27 mm. in length by .16 mm. in diameter. The covering is smooth, tough and pliable. The length of the egg stage varied from twelve to eighteen days.

The larva when first hatched is grub-like, pointed at both ends and remains curled up in the place where it hatches until after the first molt. After the first molt it becomes straight and assumes the shape characteristic of the cecidomyid larvae. The larvae grow slowly and by October or November they have molted three or four times, are about 1.5 mm. in length and are yellowish-green in color. From an examination of the stomach of a large number of larvae and from the structure of the mouth-parts, there is no evidence that they take solid food. In the early instars the food is evidently absorbed through the body and in the later stages the large juicy parenchyma cells are punctured by the breast bone and the juices sucked in through the mouth.

PLATE 4.



1, Leaf of boxwood plant showing eggs (by transmitted light); 2, Lower surface of the leaf removed showing the gall-like growth caused by the larvae; 3, Twig showing injury to leaves and pupal skins left in exit holes; 4, Adults killed before completing their emergence by spraying twig with black-leaf-40, 1 to 500.

Control Methods

Attempts have been made to control the insect under a variety of methods by different workers. Some of these include spraying with arsenical poisons to kill the adults. This work was entirely without results as the mouth parts of the adults appear rudimentary and it is probable that they take no food after emerging. Dusting with sulfur, road dust and other dusts has been tried in France with some success. The dust acts as a mechanical barrier and repels the adults when laying their eggs. Since it does not kill the insect but drives it to unprotected places, its use is not desirable if other methods for controlling it can be found. Spraying with a number of contact sprays to kill the eggs, larvae, pupae, and adults has been tried with varying success. The best results were secured by spraying when the adults were emerging. Fumigating during the larval stage with potassium cyanide, carbon disulphide, ammonia, and other gases has given some control in laboratory experiments. There are no records of its having been tried under field conditions. The only gases which killed the larvae without injuring the plants were hydrocyanic acid gas and carbon disulphide. Spraying with molasses to entangle the adults as they emerge and when laying eggs has given promising results.

The work reported upon here consists of laboratory and field experiments with molasses as a sticker, various contact sprays and fumigation with potassium cyanide and carbon disulphide.

Preliminary Experiments to Control the Adults

On May 20th, 1920, sections of an infested box wood hedge at Baltimore, Maryland, were sprayed with the following materials:

Lot No. 1. Karo syrup 1 gallon, water 2½ gallons, extract of pyrethrum 10 cc. The material spread well and upon drying gave a uniform sticky surface on new and old leaves.

Lot No. 2. Karo syrup 1 gallon, water 5 gallons, extract of pyrethrum 20 cc. This spray did not spread quite as well on new leaves as Lot No. 1.

Lot No. 3. Karo syrup 1 gallon, water 5 gallons, copper sulphate 2 ounces. (The copper sulphate was added to determine whether it would prevent mold from growing on the syrup). This lot spread the same as Lot No. 2.

Lot No. 4. The same as Lot No. 3 except that dry pyrethrum was dusted on after spraying. Spread the same as Lot No. 2.

Lot No. 5. The same as Lot No. 3 except that Corona dusting tobacco was dusted on after spraying. Spread the same as Lot No. 2.

Lot No. 6. Soluble pine tar diluted one part to ten parts of water. Spread very well on new and old leaves.

Lot No. 7. Soluble pine tar diluted one part to twenty-five parts of water. This did not spread quite as well as Lot No. 6 on the new leaves.

At the time of spraying, the adults were just beginning to emerge, probably less than 1% being out. An examination on May 21st showed that lots 1 to 5 inclusive, gave excellent results, entangling most of the adults as they emerged. Lot No. 1 gave slightly better results than the others. The extract of pyrethrum and pyrethrum dust in lots Nos. 3 and 4 did not kill any of the adults as they emerged, while lot No. 5, dusted with tobacco, killed most of the adults before they emerged completely and entangled the remainder. Lots Nos. 6 and 7, sprayed with the soluble pine tar, killed and entangled a few of the adults as they emerged but caused considerable burning.

Spraying With Molasses to Entangle the Adults

At the time the examination of the preliminary experiments was made the adults were beginning to emerge quite rapidly, about 10% being out, so arrangements were made to spray the entire hedge of about 175 yards with molasses on the next day, May 22nd. An unsprayed hedge on a nearby estate was used as a check. Black sorghum molasses diluted one part to three parts of water was used. This strength was used as the weaker dilutions did not spread well upon the new leaves and enough more spray material was used to make up for the greater dilution. It took 23 gallons of syrup, costing 50 cents a gallon to spray the hedge. Before spraying, many adults were observed flying and ovipositing. After spraying only a few unentangled adults could be found.

The sprayed hedge was examined on May 26th, at which time the adults were emerging in the greatest numbers. Very few adults were observed flying while many were stuck in the molasses on the leaves. A count of a number of sprayed twigs gave the following results: Adults emerged 652, adults entangled 557, number of leaves examined 280, number of eggs found 591, average number of eggs per leaf 2.1−, or slightly less than one egg for each adult emerging.

In the check secured by examining twigs of the same degree of infestation from an adjoining estate, 233 leaves were examined and 2351 eggs found or an average of 10^{n}. Based on the average egg infestation in treated and check leaves, there is an apparent control of 79%.

The entire hedge was resprayed the afternoon of the 26th using the same dilution as before. Twenty gallons of syrup were used for the

second application, making a total of 43 gallons. At 50 cents a gallon this gave a cost of $21.50 for materials.

A final count after the adults had all emerged gave an average infestation of 2 eggs per leaf in the sprayed hedge and 10.1 per leaf in the unsprayed hedge. This is an apparent control of 80%. As high as 68 eggs were found in a single leaf in the unsprayed hedge. Had the first spray been applied before the adults began to emerge, approximately a complete control might have been secured. To secure the best results it will probably be necessary to spray three times during the emerging period and oftener if it rains. The syrup did not mould and remained quite sticky until the 10th of June when it was washed off by a heavy rain.

Laboratory Experiments with Contact Sprays

Branches of the infested box wood plants were secured at Baltimore, brought to the laboratory and placed in water. After spraying with the desired material they were placed outdoors in the field insectary. Every effort was made to keep the twigs fresh as it was found that the larvae soon died in wilted or old leaves. Spraying experiments were started during the pupal stage and continued through the emerging and egg laying periods and up to late fall. Table No. 1, sprayed May 18th, gives some of the materials tested and the results secured.

Table No. I

Material used	No. emerged successfully	No. failing to emerge successfully	No. adults stuck to leaf	Remarks
1. Syrup 1-5	91	0	21	Many eggs deposited in new leaves.
2. Syrup 1-10	53	0	9	ditto
3. Syrup 1-5 + 10 drops carbolic acid to 20 cc.	49	0	9	ditto
4. Syrup 1-5 + ½ gm. HgCl to 20 cc.	6	0	10	No new leaves.
5. Syrup 1-5 + 10 drops creosote merck to 20 cc.	79	0	15	Strong odor, but not lasting. A few eggs laid.
6. Syrup 1-5 + B. L. 40 1 to 100	0	27	5	No eggs laid. 15 dead pupae in leaves.
7. Syrup 1-5 + pyrethrum extract 1-100	49	9	30	No eggs laid. No new growth.
8. Syrup 1-2.5 + pyrethrum extract 1-100	112	9	87	New growth sticky. Very few eggs laid.
9. Syrup 1-5 + pyrethrum powder 1 gm. to 20 cc.	141	0	27	Not sticky after drying. Very few eggs laid.
10. Syrup 1-5 + corona dusting tobacco 1 gm. to 20 cc.	18	43	21	Not sticky after drying. No eggs laid.
11. Pyrethrum extract 1-100	116	0	3	Eggs common but not numerous in new growth.
12. "Pinetrex" 1-25 + pyrethrum extract 1-100	130	0	8	Slightly sticky. A few eggs laid.
13. "Pinetrex" 1-25 + B. L. 40 1-100	36	41	0	Very few eggs laid.
14. Pinetrex 1-25	57	7	4	Eggs common but not numerous.
15. Pinetrex 1-50	56	6	5	ditto
16. Pinetrex 1-10	84	1	3	Fairly sticky. Only a few eggs laid.

Lots numbers 1 to 4, 5 to 8, 9 to 12, and 13 to 16 inclusive were placed together in screen cages. Lot number 7, consisting of syrup diluted one part to five parts of water plus Black Leaf 40, one to 100, gave the best results. No adults emerged successfully, 27 being killed befor completing the emergence and 15 pupae dead in the leaves. Lot number 10, in which tobacco dust was added to the syrup gave good results, 18 emerging successfully, 43 failing to emerge successfully, and 21 entangled in the syrup. Lot number 13, consisting of soluble pine tar plus Black Leaf 40 gave good results while the tar used alone did not show much promise.

Later experiments with Black Leaf 40 and Black leaf-resinate diluted 1 to 500 gave excellent control. The following table is typical of the results secured.

TABLE NO. II - RESULTS SECURED BY SPRAYING INFESTED TWIGS WITH BLACK LEAF 40 AND BLACK LEAF-RESINATE DILUTED ONE PART TO 500 PARTS OF WATER

Spray material	No. adults emerging successfully	No. adults failing to emerge successfully	No. pupae dead in the leaves	Percent killed
Black Leaf 40	5	28	55	94.3
Black Leaf resinate	4	40	111	97.4
Check	24	1	4	17.2

A good killing effect was obtained 4 and 5 days after spraying. Figure 4 shows the adults killed as they emerged after having sprayed the leaves with Black Leaf 40 diluted 1 to 500. Unfortunately, the adults emerged so rapidly that no time was available for testing Black Leaf 40 under field conditions. Soap added to the spray at the rate of 4 pounds to 50 gallons of water gave slightly better results by increasing the wetting properties of the spray. The results secured in the laboratory tests would indicate that the adults might be controlled under field conditions by spraying at intervals of 4 or 5 days during the emerging period.

Spraying experiments with Black Leaf 40, pine tar dilutions, and pyrethrum extract during the egg and larval stages gave only slight control.

FUMIGATION EXPERIMENTS WITH HYDROCYANIC ACID GAS AND CARBON DISULPHIDE

Laboratory experiments with hydrocyanic acid gas and carbon disulphide gave results approximating those reported by Felt in the Journal of Economic Entomology for 1915. Young larvae in infested

twigs fumigated with potassium cyanide at the rate of one and two ounces per thousand cubic feet of air space for two hours killed approximately 70% of the larvae, without any injury to the leaves. When the time was increased to six hours, using the same strengths, all the larvae were killed but considerable wilting of the leaves resulted. Carbon disulphide at the rate of 20 drops to 720 cubic inches for 70 minutes killed 60% of the larvae. The dose was increased to 40 drops and 85% of the larvae were killed. No injury resulted to the plants in either case. In the check twigs 30% of the larvae were found dead. The results in the different fumigation experiments varied considerably and considering the attending danger it would probably not be advisable to fumigate for control under field conditions.

Summary

1. The adults may emerge from the middle of May to early in June. They commence laying eggs soon after emerging and then die.
2. The best time for controlling the insect is while the adult is emerging from the pupal skin.
3. Spraying with molasses, diluted one part to three parts of water, gave the best results, entangling the majority of the adults as they emerged or before laying eggs. The under surface of the old and new leaves must be thoroughly covered with the molasses spray, and the spraying must be repeated often enough to keep them sticky.
4. Laboratory experiments, spraying once with Black Leaf 40 and once with Black Leaf-resinate, diluted one part to 500 parts of water, killed approximately 80% of the adults before they emerged successfully. A killing effect was noted four and five days after spraying. Spraying should probably be repeated at intervals of not less than four or five days during the emerging period.

INJURY TO STRUCTURAL TIMBER BY LEPIDOPTEROUS LARVAE

By THOS. E. SNYDER, *Bureau of Entomology, U. S. Department of Agriculture*

Recently, Mr. T. D. J. Fuller, an architect of Washington, D. C., called Mr. C. L. Marlatt's attention to the injury done by "fleshy worms" to cypress pilasters of a beautiful new residence being built on the forested bank of the Potomac River about one mile north of Chain Bridge. At the request of Mr. Marlatt, I made an examination of the building on October 15, 1920, anticipating that the damage would probably be due to either Bostrichid or "ambrosia" beetles.

A superficial examination of the damaged pilasters, which had been well painted with a white lead paint previous to attack by insects, confirmed this preconceived diagnosis. Small circular holes about $\frac{1}{8}$ inch in diameter were found penetrating the wood not only of the pilasters but were also in cypress columnar (hollow) pillars, window sills, frames and other woodwork, all of which had been painted. The holes were especially numerous at cracks and points of juncture, such as the molding of the pilasters, etc., which is normally the case in Bostrichid damage, the insects being enabled to obtain a purchase or support by means of which the wood is more easily penetrated. The wood at such places looked as if it had been "riddled" with BB shot. In quite a few instances, especially where the insects had attempted to enter the wood at a distance from cracks or joints, the holes were incompleted, i.e., only slightly penetrated the wood.

What was my surprise upon inserting forceps into one of the completed holes to pull forth a wriggling Lepidopterous larva with "sordid white"[1] body and brown head, about one inch long. Further examination showed that the larval burrows branched at right angles to the entrance holes and extended longitudinally with the grain of the soft cypress wood either up or down the pilaster. The burrows were only slightly wider than the larvae. Sometimes frass protruded from the entrance holes, being loosely held together by webbing.

These larvae were submitted to Mr. Carl Heinrich for determination and proved to be the Polygonum feeder (*Pyrausta ainsliei* Heinrich), a native American species of the family *Pyralidae* closely related to the notorious European corn borer (*P. nubilalis* Hübner). *Pains-*

liei, according to Heinrich,[1] has the following food plants: *Polygonum* ("jointweed", "knotweed", "smartweed"), *Ambrosia* ("ragweed", "wormwood"), *Xanthium* ("clotbur", "cocklebur"), *Eupatorium* ("Joe-Pye Weed"), and corn, etc.

The insect, according to Heinrich,[1] occurs from Quebec south to Tennessee.

The house is set in open woodland with undergrowth of weeds, which also occur along the private road leading from the Fairfax "pike" to the house. Joe-Pye Weed was growing along the private road of this estate and its fruit was ripe. A small patch of corn still stands near the house. The larvae merely bored into the soft cypress wood for hibernation quarters, not feeding on the wood at all and hence not being deterred by the paint. Very probably larvae are also hibernating in the dry corn stalks.

Remedies suggested were to mow down and burn the weeds and the corn stalks. Carbon disulphid was inserted into the holes in the woodwork of the house by means of a medicine dropper and the entrance plugged with putty and then painted over. It was suggested that some of the badly bored molding of the pilasters be replaced.

From past experience it was not believed that any chemical preservative treatment of the wood would be of any value since the treatment would necessarily have to be superficial. At Falls Church, Va., on October 31, 1916, brown cocoons spun by large Lepidopterous larvae (*Notodontid*) were found on an experimental yellow pine 2″ x 4″ x 3′ stake, which had received a heavy treatment with creosote. In spinning the cocoons the larvae had cut oval hollows to the depth of $\frac{1}{8}$ inch into the wood, in order to form a protective base for their cocoons. Mr. Heinrich has identified these larvae as *Cerura multiscripta* Riley, adding the statement that:

> The larva of this genus normally scoops out a hollow in the wood of trees, shrubs or other convenient things, using the chips in making the cocoon which is a covering over the hollowed-out place. They do not feed on the woody tissue or otherwise attack it.

Mr. H. S. Barber states that several years ago Lepidopterous larvae made similar excavations in the cypress shingles roofing the cabin at Plummers Island, Md.

Since these larvae were not deterred by the creosote treatment—and coal-tar creosote is one of the most effective wood preservatives known—

[1]Heinrich, Carl. Note on the European Corn Borer (*Pyrausta nubilalis* Hübner) and its nearest American Allies, with Description of Larvae, Pupae, and One New Species. Jour. Agric. Res., Vol. XVIII, No. 3, Nov. 1, 1919, pp. 171-178.

boring into timber by Lepidopterous larvae for the purposes of hibernation or transformation cannot be prevented by chemically treating the wood. The wood excavated is not eaten.

Mr. August Busck states:

In the fall of 1901 or 1902 a similar extensive infestation was observed by me in a new cypress fence and the corner post of a chicken house in the N. E. suburbs of Washington, D. C. Hundreds or more larvae were dug out. Mr. T. Pergande thought these were a *Pyrausta* larva infesting an adjoining corn field.

In November 1919 the Superintendent of Shops of the Atchison, Topeka and Santa Fe Railway Co., Los Angeles, Calif., reported that refrigerator car No. 4901 "came in full of worms. There are thousands of these worms in this car and they are literally demolishing it." *** "This is the second car of this kind that we have had in here recently."

Samples of the damaged wood from this car were sent by the Superintendent and showed that the damage had been done by medium sized Lepidopterous larvae which had cut into the wood in order to obtain a sheltered and protected place to spin their cocoons and for transformation and not to feed on wood. Larvae and chrysalides in cocoons were found in cavities scooped into the wood. Mr. Heinrich identified the insect as a species of *Olethreutidae*, a group formerly included under the old family *Tortricidae*.

In this case the damage was more or less superficial and the wood was probably not structurally weakened but of course the appearance of the car was ruined.

Mr. J. A. Hyslop has given me a specimen of the white pine woodwork of a beehive from Montgomery Co., Md., which has been badly grooved by the destructive wax-worm or the larvae of the bee-moth (*Galleria mellonella* Linn., family *Galleriidae*), one of the microlepidoptera. Such damage to beehives is not uncommon in the United States. F. B. Paddock[1] states:

Although the frames and hive are eaten out for pupation it is doubtful if the wood is a food, but probably it is used slightly in the construction of the cocoon.

The larva prefers to get into a place which it can chew in order that a cavity may be constructed and the cocoon thus be better protected.

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[1]Paddock, F. B. "The Beemoth or Waxworm." Bull. No. 231, Texas Agric. Exp. Sta., June, 1918.

It is believed that these instances of damage to timber by phytophagous but non-wood-boring Lepidopterous larvae are unusual and of especial interest; however, such damage is of only occasional occurrence and more or less accidental. Nevertheless, the damage to the railway car in California and the building in Virginia is of no little economic importance. Of particular interest is the instance of damage to creosoted wood.

NOTES ON THE CARPENTER WORM (*Prionoxystus robiniae* Peck) AND A NEW METHOD OF CONTROL

By H. E. BURKE, *Specialist in Forest Entomology, Forest Insect Investigations, Bureau of Entomology, U. S. Department of Agriculture*

One of the worst pests of the native live oak (*Quercus agrifolia*) and the introduced elms (*Ulmus campestris* and varieties) in California is the carpenter worm. The trunks of many of the finest street and yard trees are riddled by its large winding mines. The dirty brownish borings cover the bark and the ground at the bases of the trees and the entire trunk takes on a very disagreeable appearance. As the work continues year after year and the tree tries to heal over the wounds, the bark becomes roughened and unhealthy looking and the tree apparently is more susceptible to new attacks. Fortunately most of the mining is done in the wood and for a number of years the health of the tree appears to be little affected. In the worst cases, however, the tree is unable to overcome the repeated attacks and dies.

The writer has seen live oaks killed by this species at Palo Alto and Santa Barbara and elms in San Jose. There are some heavily infested trees at Los Gatos. Mr. R. D. Hartman observed the work to be common in the live oak in the Niles canyon in Alameda County and Mr. C. M. Packard reports elms badly infested in Sacramento.

Besides the live oak and the elm, the California hosts of the carpenter worm observed by the writer are the white oak (*Q. lobata*), the willow (*Salix lasiolepis*) and probably the cottonwood (*Populus trichocarpa*). We have not found it in the black locust (*Robinia*) which was the original host reported in the Eastern states. An attempted introduction in the blue oak (*Q. douglasii*) failed. Childs (Month. Bul. Calif. State Com. Hort., Vol. 111, p. 264) gives locust and carob as additional hosts.

On September 14, 1917 a heavily infested live oak, fourteen inches in diameter and with a main trunk height below the branches of about ten feet, was found in the grounds of the Forest Insect Laboratory at Los Gatos. Larvae, apparently from eggs laid in 1916, from three fourths to one inch long were found in mines in the bark and on the outer surface of the wood. Larger larvae, apparently from several older generations, from two and a half to three inches long were found in mines which ran deep into the wood. Reddish borings were common on the bark and on the ground at the base of the trunk. The infestation extended from the ground into the bases of the larger branches.

The tree offered such a good chance for life history work that a cage was built around the main trunk. This consisted of a light redwood framework, three feet by three feet square and ten feet high, sixteen mesh galvanized wire screen walls with a door in one side and a canvas top closely fitted about the trunk and the bases of the larger branches.

That such a cage is well worth its cost is proven by the interesting results obtained. In 1918 seven moths emerged and were captured. Six were males and one a female. In 1919 nine emerged, five males and four females and in 1920 thirty-four emerged, fifteen males and nineteen females. This makes a total of fifty moths reared in the cage during the three years. Twenty-five of these are males and twenty-four females. Besides the moths reared in the cage nine males were attracted to the cage from outside trees. Five of these came in 1919 and four in 1920.

In 1918 the first emergence occured on May 21st, in both 1919 and 1920 it occured May 19th. The last emergence of the year occurred June 12 in 1918, June 24 in 1919 and June 21, 1920. Nineteen of the males were found in the cage during the forenoon hours and seven during the afternoon while fourteen of the females were found in the forenoon and ten in the afternoon. All of the males attracted from the outside came in the afternoon.

It should be noted here that all of the moths that emerged in the cage were taken out as soon as noticed so that there would be no chance of reinfestation from them. The records therefore indicate that the life cycle is at least three years. Borings are still coming out of the wood so the probabilities are that it is longer.

Methods of control for the carpenter worm in the West have been recommended by several writers. Doten (Nev. Agric. Exp. Sta. Bul. 49, pp. 11,12) recommends cutting down and destroying all wormy willows, poplars, cottonwoods and badly infested elms to save the bet-

ter elms. Slightly or moderately infested elms are to be treated by cutting out and probing for the smaller larvae, probing for larger ones and injecting carbon bisulphide in the mines of those that can not be reached by the former methods. Doane (Jour. Econ. Ent., Vol. 5, p. 348) recommends the carbon bisulphide injectment treatment. Childs (Month. Bul. Calif. State Com. Hort. Vol. 111, p. 264) also recommends the bisulphide treatment and the removal of unimportant trees which harbor the pest.

The above mentioned methods are undoubtedly good and when carefully and patiently applied will bring success. It is doubtful, however, if the average gardener or arboriculturist can follow up a heavy infestation thoroughly enough to stop it. From a single elm stump about twelve inches high and eighteen inches in diameter left in control work the writer took twenty-six larvae which varied from one inch to two and a quarter inches in length and which appeared to belong to at least four generations. Following up each mine of such a heavy infestation in a large tree and either catching the worm or killing it by fumigation is very tedious and takes considerable time and skill which makes it expensive.

There is one splendid live oak in Los Gatos which is worth easily $1500.00 to the property on which it stands. It is four feet in diameter, had a main trunk height of about twelve feet, a total height of fifty-five feet and a spread of sixty feet. The foliage is in almost perfect condition but the main trunk and the bases of the larger branches are much scarred by the work of the carpenter worm. During the past ten years the owner has spent about five hundred dollars for protection, yet the tree is still infested with several generations of worms.

The work of the insect was noticed first in this tree about ten years ago. The trunk was heavily infested so a tree surgeon was employed. He went carefully over it, cut off most of the bark and so far as can be determined did a very thorough job. For about four or five years afterwards the tree appeared to be in very good condition and no insect work was noticed. The trunk then became infested again and the regular gardener was put to work on it. He consulted all of the authorities he could find and was given the standard recommendations. These he very faithfully tried to carry out but the tree still showed signs of infestation so last spring he went over the trunk again, cutting out worms and injecting carbon bisulphide and to complete the job gave it a heavy coat of white wash and sprayed it during the first of July with strong kerosene emulsion. The white wash made the over-

looked old infestation and the new infestation much easier to locate, but neither it nor the emulsion prevented egglaying or injured the eggs after they were laid as there is considerable new brood in the bark at the present time.

Cutting into the bark after the worms appears to make the tree more attractive to the female when she is looking for a place for her eggs. The usual control therefore, while it may destroy all of the infesting larvae, is apt to leave the tree in a specially attractive condition for succeeding generations. To overcome this difficulty, to reduce the cost and to give better control for valuable trees, a new method has been suggested by the writers experience with the cage mentioned in the first part of this article.

Such a "knock down" cage with a light wooden frame work, galvanized wire screen walls with a door in one side and a burlap or canvas top can be built for the average California tree at a total cost of about $25.00. It should be put up about May 1st and kept up until the last of July. It will catch all of the moths that emerge from within and will prevent the egglaying of those from without. As long as the tree is infested and the moths emerge some one should visit the tree at least once a day to catch and kill those that have emerged. As they are moderately large and usually fly to the screen and remain quiet they are easily seen and captured.

Our records indicate that even where a tree is heavily infested it is not often that males and females emerge the same day and that when they do the males either are not sexually mature or at least are not attracted to the females from their own tree. There is thus practically no danger of reinfestation from within if the moths are taken once a day.

As a tree that has been infested once remains attractive for some time it should be caged every year for several years after all moths have emerged from the trunk. Once a cage has been built it will last for a number of years and might as well be used to protect the tree until it wears out. The cost of putting it up, taking it down and caring for it will be far smaller than the cost of any other method now known for the control of a heavy infestation of the carpenter worm in large valuable trees.

Scientific Notes

Pear Midge. On examining a number of pear trees in Ithaca, N. Y., I found a heavy infestation of the pear midge (*Contarinia pyrivora*). In one tree where there was promise of a good crop the loss appears to be total. Some of the pears are turning a rusty color while others have completely dried up. As many as thirty larvae, and even more, may be found in a small pear not more than two-fifths of an inch long. Some of these larvae reached maturity, by May 18 and were dropping to the ground.

JOHN D. DETWILER

A New Almond Aphid. A severe attack of a species of aphid new to the almond has appeared throughout the Sacramento Valley, California. The species was identified by professor Essig as *Rhopalosiphum nymphæ* Linn., this being apparently the first recorded attack of this aphid on almond although it is frequently found on plums. Liquid applications of nicotine sulphate, 1 in 1000 plus sufficient soap to give a "sudsy" effect have proven superior to nicotine dusts 2% strength. The latter was effective when applied in quantity to the body of the aphid, but indirect applications, resulting from the dust drifting in the wind, were ineffective.

E. R. de ONG
University of California

Camphor Scale in New Orleans. At a meeting of the Louisiana Entomological Society in April Mr. E. R. Barber, of the U. S. Bureau of Entomology, made a talk on a newly introduced scale insect, *Psudaonidia duplex*, which he reported as killing camphor trees in a limited area in New Orleans. Resolutions were adopted by the Society calling the attention of the city and state authorities to this matter, and reports of the action taken were furnished to the daily papers. Some publicity was secured, and Mr. Barber was afterwards asked to make talks on the scale at meetings of various local secieties. The Bureau later sent Mr. Harold Morrison to look over the situation, and he submitted a detailed report in which he recommended taking steps to control the scale wherever it is established. At Mr. Barber's suggestion, backed by the Association of Commerce and the Horticultural Society, the City Commission Council of New Orleans has voted $5,000 toward control work, with a promise of as much more money as may be needed to carry on the work till funds from other sources have been secured. Badly infested trees are being cut down by the City Parking Commission, and the Bureau is sending a spraying expert to take charge of the work. In the meantime Mr. Barber has been studying the scale, and has taken it on upwards of 100 plants. Camphor seems to be the favorite host plant, but *Ligustrum*, rose, *Citrus*, fig and sweet olive are also injured.

T. E. HOLLOWAY
Secretary-Treasurer, Louisiana Entomological Society

Cotton Boll Weevils. During the past March and April the writer had an opportunity to investigate cotton conditions on the West Coast of Mexico from Hermosillo south as far as Villa Union, near Mazatlan. Realizing that among the many specimens of boll weevils collected from wild and cultivated cotton there were typical *grandis*, typical *thurberiae*, hybrids and races of various kinds the writer selected a

series of 31 specimens and consulted with Dr. W. Dwight Pierce, in regard to the taxonomy. Dr. Pierce, has examined the series and his determinations are incorporated in the following brief records:

Hermosillo, Sonora, typical *thurberiae* 1 male and 3 females, from cultivated cotton source of infestation probably wild cotton: Colcorit, Sonora, race near *grandis* with dense pubesence, tooth on middle femora tending toward *thurberiae*, 3 males and 1 female, from wild cotton; Cejame, Sonora, 6 males, 1 female, all typical *thurberiae*, from wild and cultivated cotton; Constancia, Sinaloa, 1 male typical *grandis*, 1 female *grandis* tending toward *thurberiae*, 1 female and 1 male very near to typical *thurberiae* all from cultivated cotton, source of infestation probably wild cotton; Los Mochis, Sinaloa, 1 typical *Grandis*, from wild cotton: Navalota, Sinaloa (near Culiacan) typical *grandis*, 2 females and 2 males, from cultivated cotton; Villa Union, Sinaloa, 1 male and 1 female typical *thurberiae*, 3 females and 3 males near to typical *grandis* but all apparently hybrids, from cultivated cotton.

It is interesting to note that conditions in regard to handling of seed cotton and sources of seed for planting purposes were such that both hybrids and typical forms were more likely to occur at Villa Union than at any of the other localities named. Active adults of both typical, arietal and intermediate or hybrid forms were found in large numbers on cultivated cotton at this point. Bolls appeared to be greatly preferred to squares for egg deposition, a characteristic of the variety *thurberiae*.

A. W. MORRILL

An Early Record Regarding Bot Flies. Until recently little or nothing was known of the manner by which oestrid larvae reached the interior of their hosts. For Hypoderma bovis and H. *lineata* this has been demonstrated by Hadwen and others.

Not long ago an interesting reference relating to oestrids was found while consulting some old literature. It consists of a communication written by a Dr. Hamlin of Greene County, N. Y., and appeared in Volume VI of the Medical Repository (1808). The section pertaining to penetration of the larvae follows.

"The next difficulty that presented, was to ascertain how the bot insinuated itself into the bowels of the horse. I found the horse frequently to bite and rub the part in the vicinity of those nits, which led me to believe that he swallowed some of them with his food, and they produced the bot after being in the stomach; but the observations that I have since made, lead me strongly to suspect that I was mistaken in that particular; for on separating the hair in the vicinity of those nits, and viewing the skin minutely, I could discover these insects with the naked eye; and on taking a look through a magnifier could see a great number of them; and they appeared to be insinuating themselves into the texture of the horse, through the pores of the skin. I must leave it to more able naturalists to determine the reasonability of the above conjecture; but it is a fact that some had so far penetrated into the skin as to be almost out of sight."

It would seem that the species under mention was *Gastrophilus intestinalis*, though the consensus of opinion supports the ingestion method. However, the writer, though he apparently had no knowledge of entomology, nor access to bibliography such as Clark, specifically mentioned the species as being a bot fly. There is also a chance that the insect belonged to the genus *Hypoderma*, members of which Dr. Ransom informs me infest the horse, though not nearly as commonly as *Gastrophilus intestinalis*. The communication is of interest, since it records actual penetration of larvae, an observation which does not seem to have been noted again for more than a century.

W. A. HOFFMAN

Albany, N. Y.

THIRTY-FOURTH ANNUAL MEETING, AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

The meeting will be held at Toronto, Canada, Thursday, December 29, to Saturday, December 31, inclusive.

On Friday, a joint session will be arranged with Entomological Society of Ontario.

The Entomological Society of America will meet on Tuesday and Wednesday of the same week.

Hotel headquarters have been selected at the Prince George Hotel, where the following rates have been secured:

(On the European Plan)

One person to a room, without bath, $2.50 and up.
Two persons to a room, without bath, $5.00 and up.

One person to a room. with bath, $3.50 and up.
Two persons to a room, with bath, $6.00 and up.

Hotel accomodations are limited in Toronto, and it will be necessary for members to engage reservations early.

It will add greatly to the success of the meeting if members will make reservations at once.

A. F. BURGESS, *Secretary*

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

AUGUST, 1921

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published as far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Contributors are requested to supply electrotypes for the larger illustrations as far as possible. Photoengravings may be obtained by authors at cost. The receipt of all papers will be acknowledged.—Eds.

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The need of natural or biological methods for the control of recently introduced pests is emphasized by recent developments in the case of the European corn borer and the conditions in the territory infested by the Japanese beetle. Both of these insects are not easily checked by the more customary repressive measures. Both are spreading and each is a real menace to valuable crops. The history of other introduced insects indicates a period of severe, usually somewhat local injury followed by a more or less gradual reduction in the number of the pests as a consequence of parasite attack, fungous infection or a failure on the part of the insect to continue to respond favorably to climate or other conditions. The relation of an insect to its environment is an exceedingly complex problem and it is practically impossible to forecast the factor or factors destined to bring about a more satisfactory condition. Direct or artificial methods of control should be regarded as somewhat temporary expedients, pending the discovery of more satisfactory ways of dealing with the situation. This is especially true of the field and forest crops where low values prohibit the adoption of systematic spraying or other treatments so common in orchards and it is by no means impossible that the costly schedule of the fruit grower may not eventually be replaced by methods more in harmony with the natural plan of "live and let live," except that there will always be a tendency to turn such forces to man's advantage and it is certainly advisable to avoid, so far as practicable, conditions favorable to injurious insects. This last may have much greater significance than most realize and the possibilities along this line have by no means been exhausted.

MR. N. V. KURDIUMOFF, RUSSIAN ENTOMOLOGIST DIED 1917.

By Dr. D. Borodin

In Memoriam

From correspondence which I have had with American entomologists since I arrived in this country, I see that the name of N. V. Kurdiumoff is well known here, but that many do not know about his tragic death. I therefore take the liberty, as one who knew him well and who had been working in the same city with him, to make a brief statement of his life and work.

N. V. Kurdiumoff was born in 1882 in the Kursk district. After graduating from the High School there, he entered the Polytechnical Institute of Kief, studying in the College of Agriculture, and receiving his degree.

The liberal political movement which at that time absorbed the best ranks of the Russian students captivated him, and he was often heard as a brilliant speaker and a determined enemy of the old regime.

His yearning for knowledge and desire for improvement impelled him to leave Russia in 1911, when he came to America and worked under the guidance of Doctor Howard in the Bureau of Entomology, visiting also a number of field stations, notably the one under the direction of Dr. W. D. Hunter in Texas. He returned to Russia, filled with the aspiration to apply all the knowledge acquired in the United States under the guidance of his teacher, Doctor Howard, who is famous throughout the whole world.

After his return to Russia, he orgarized a Department of Entomology on the plan of similar institutions in the United States, selecting as his station the oldest Russian Agricultural Experiment Station at Poltava, famous for the early research work of Metchnikoff. He founded a great library, in which were collected the principal entomological works of America and Europe.

He worked indefatigably and did not lose contact with the United States. He studied the life histories of several new and very little-known injurious insects, and published a number of works which have become standards of Russian investigations, applying at the same time the methods invented by the bright American school to the Russian territory.

Having specialized under Doctor Howard's direction in the study of the Chalcidoidea, he described certain new species of this group, as well as certain species of thrips.

Dissatisfied with the inaccurate data concerning the amount of injury caused by different species, he drew attention to the necessity of an exact investigation of this subject. He made one reflect seriously upon different phenomena which had previously been admitted as unnecessary of further verification.

In his writings, and also at the congresses of entomologists in Russia, he demanded that an exact investigation be made of the full life histories of different species,and accurate studies as well of their injurious influente upon plants. He demanded the establishment of certain laws of phenomena, following the example of similar work in the United States, since he was always a promoter of American methods in Russian investigations.

With his great desire for knowledge, he went in 1913 to Sweden and England in search of detailed information as to what had been done with *Oscinis frit L.*, in which he was especially interested at that time.

The world war found him at the highest point of his investigations of *Chaetocnema aridula* Gyll., an enemy of wheat. Always a determined enemy of German imperialism and militarism, he entered the Russian army as a volunteer at the same period as did the writer. He started as a simple soldier, took part in several serious engagements and received the highest reward for bravery, the Cross of St. George of the first class.

During his short furloughs from the active army, Kurdiumoff always visited the Poltava Station; in fact, I saw him there for the last time in November, 1915, when I was wounded and had been sent there to recuperate. I had been making some observations upon *Diplosis tritici* Kirby, and he identified the parasites I had reared.

His interest in entomology was overwhelming, and he spent hours at the binocular while in uniform. During the later years of the war, when he had become a lieutenant of artillery, he was engaged in defending the banks of the Dvina river, near Kreisburg.

The news of the revolution in February, 1917, reached him on this front, and he greeted the event with enthusiasm. He could not endure, however, the breaking up of the army which followed the revolution, and among the wire entanglements and the guns deserted by his soldiers in front of the German fortifications, he committed suicide in the autumn of 1917, leaving a series of letters written to his friends.

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Reviews

The Crane Flies of New York, Part II, Biology and Phylogeny by CHARLES PAUL ALEXANDER, Cornell University Agricultural Experiment Station, Memoir 38, p. 691–1133, 539 figs., 1920.

This is a most worthy continuation of the Crane Flies of New York, Part I, dealing with the distribution and taxonomy of the adult flies and appearing as Memoir 25. The author, in this latest contribution, presents a well balanced account of the biology and phylogeny of this large group based upon a study of the immature stages and as an outcome of his studies extending over a number of years, we have very suggestive data respecting all the important tribes and subtribes and most of the genera. The author places the Crane Flies in four families, namely, Tanyderidae, Ptychopteridae, Rhyphidae and Tipulidae, the last being divided into 19 subtribes. There are keys for both larvae and pupae to the subdivisions and most genera as well as most careful descriptions, many original, of the immature stages and detailed biological notes. The author is to be congratulated upon having made such material additions to our knowledge of this group.

Copies of this Memoir will be sent to those interested in this field of research as long as the supply lasts. Address requests to Office of Publication, College of Agriculture, Ithaca, N. Y., and ask for M–38. E. P. F.

Applied Entomology, An Introductory Text-book of Insects in Their Relation to Man by H. T. FERNALD, pp. i–xiv, 1–386, 388 figs., McGraw-Hill Book Company, Inc., New York, 1921.

The author admirably describes this latest addition to entomological literature as "a classroom text for an introductory course * * * which shall give a general idea of insects, their structure, life histories and habits, with methods for the control of insect pests in general, followed by a more thorough study of the more important ones found in the country." It is primarily a textbook concerned first in placing insects in relation to the animal kingdom, in defining their general characters and explaining both the external and internal structure. Then comes an outline of the development of insects, a discussion of the losses caused by these pests, and four excellent chapters on control methods and materials used therefor, namely insecticides.

The author recognizes more orders than most writers on applied entomology. The treatment is primarily taxonomic and in the discussion of each group one finds an estimate of its economic importance. Concise accounts are given of the more injurious species in each order, those relating to insects of general distribution being in large type while the more local or minor pests are treated of in small type.

The problems of proportion and selection incident to the production of such a work have been solved in a very satisfactory manner. The long series of illustrations have been drawn from many sources, some from European works and not a few being original; in general, they are the best extant. There has been similar selection of subject matter and a high standard unusually comprehensive textbook produced. Both author and publisher are to be congratulated.

E. P. F.

Current Notes.

The summer meeting of the Michigan State Beekeepers' Association was planned to be held at Alpena, August 3 – 4.

Dr. W. E. Britton, State Entomologist of Connecticut gave an illustrated lecture, June 13, before the New York Florists' Club.

Announcement has been made that the Ohio State Beekeepers' Association would hold a field meeting at Ashtabula, August 20.

The third annual meeting of the Wisconsin State Beekeepers' Association was scheduled to be held at Chippewa Falls, August 15 – 20.

Mr. Leonard S. McLaine, Chief, Division Foreign Pests, Entomological Branch, Canadian Department of Agriculture, has returned from a trip to Europe.

Science states that Mr. A. Musgrave, is to fill the vacancy caused by the death of W. J. Rainbow, as Entomologist on the staff of the Australian Museum at Sydney.

Recent transfers in the Bureau of Entomology are as follows:– W. B. Turner, Corn Borer work to Sacramento, Calif; E. M. Searls, Silver Creek, N. Y. to Madison, Wis.

The Connecticut Beekeepers' Association held its summer meeting at Storrs, during Farmers week, August 2 – 5. Dr. E. F. Phillips, and J. E. Crane were among the speakers.

Mr. Frank Hennessey has been appointed artist and photographer of the Entomological Branch, Canadian Department of Agriculture, in place of Mr. Arthur Kellett, resigned.

According to the Experiment Station Record, Rev. C. J. S. Bethune, for fifteen years professor of Entomology at Ontario Agricultural College, has resigned to return to private life.

Dr. Herbert Haviland Field died at Zurich, Switzerland, April 5, 1921, aged 53. He organized at Zurich, in 1895 the Concilium Bibligraphicum which it is understood will be continued.

Mr. W. H. Goodwin formerly an assistant in the Entomological department of the Ohio Agricultural Experiment Station is again helping with the insect work during the summer months.

Mr. W. D. Whitcomb of the U. S. Bureau of Entomology who has been assisting with the curculic work at Fort Valley, Ga., has returned to his permanent station at Yakima, Washington.

A field meeting of the Eastern Massachusetts Society of Beekeepers at Dedham, August 6, was announced. Dr. E. F. Phillips, of the Bureau of Entomology was expected to be the principal speaker.

Mr. R. N. Bissonette, field crop and garden insects, and Mr. F. H. Peck, messenger at headquarters have been appointed temporarily to the Entomological Branch, Canadian Department of Agriculture.

Dr. W. Dwight Pierce, Managing Director Biological Departmet, The Mineral Metal and By- Products Co., formerly of Denver, Colorado, has moved his head quarters to Wisnom Building, San Mateo, California.

Mr. Oliver I. Snapp in charge of the U. S. Peach Insect Laboratory at Fort Valley, Georgia, spent a part of July in the Southern Pine and Pinehurst peach section o North Carolina in connection with curculic control work.

According to *Science*, Indiana University has conferred the degree of Doctor of Laws upon W. S. Blatchley, formerly State Geologist of Indiana and author of "The Coleoptera of Indiana" and the "Orthoptera of Indiana."

Mr. F. C. Bishop of the Dallas (Texas) laboratory of the Bureau of Entomology, i in New York State, where a series of experiments are being conducted in the contro of ox warble among dairy cattle.

Current Notes

Dr. A. E. Cameron who resigned from the Entomological Branch, Canadian Department of Agriculture, in October 1920, has been re-appointed as temporary entomologist for the present season, and will have charge of a laboratory at Saskatoon, Saskatchewan.

An important meeting of official entomologists of the Federal and Western provincial Governments, Dominion of Canada, was held at Regina, April 12. Mr. Norman Criddle of Treesbank was elected chariman. Representatives were present from Minnesota, Montana and North Dakota.

Prof. Z. P. Metcalf of the North Carolina State College and Experiment Station, was the retiring president of the North Carolina Academy of Science and gave "The Age of Insects" as his presidential address at the recent annual meeting.

Mr. L. S. McLaine, Chief of the Division of Foreign Pests Suppression, Entomological Branch, Canadian Department of Agriculture, sailed from Montreal on May 6, to visit England, France, Holland and Belgium. While there he will visit the larger nurseries and confer with the respective government officials regarding nursery nspection work.

According to *Science*, George M. Wheeler Ph.D. (1921) Bussey Institution, has been appointed instructor in Entomology, and William E. Greenleaf, instructor in Zoology, in the Zoology department, Syracuse University.

Mr. C. H. Brannon, a graduate of the Mississippi Agricultural and Mechanical College has been appointed field assistant in the U. S. Bureau of Entomology for duty at Fort Valley, Georgia, in connection with curculio work.

Resignations from the U. S. Bureau of Entomology, recently announced, are as follows:– C. K. Fisher, Wichita, Kans, to enter the States Relations Service in Virginia; R. H. Van Zwaluwenburg, Hagerstown, Md., to enter commercial Entomology in Mexico.

Mr. John B. Gill of the U. S. Bureau of Entomology has returned to his permanent station at Brownwood, Texas, after spending five months at the U. S. Peach Insect Laboratory, Fort Valley, Ga., assisting with extensive dusting and spraying experiments.

According to *Science*, Professor G. F. Ferris of Leland Stanford University, California, is spending the summer collecting and studying scale insects in Texas, in co-operation with the Division of Entomology of the Texas Agricultural Experiment Station.

Mr. Burl A. Slocum has been appointed Bee Specialist in the State of Washington. His time will be equally divided between the Division of Apiculture under Dr. A. L. Melander, and the Extension Service under Dr. S. B. Nelson. Mr. Slocum is a graduate of the University of Wisconsin in the Beekeeping course.

Professor S. A. Forbes, University of Illinois, and Professor Herbert Osborn, Ohio State University, attended a conference on conservation of resources of interior waters, at Fairport, Iowa, June 8–10. This conference was called by the Secretary of Commerce; Professor Forbes was chairman and Professor Osborn was one of the vice-chairmen.

Dr. L. O. Howard acted as toast-master and Dr. E. D. Ball, was one of the speakers at a farewell dinner at the Cosmos Club, Washington, June 17, given by the bureau chiefs to Dr. Carl L. Alsberg, who has resigned as Chief of the Bureau of Chemistry to become one of three directors of the Food Research Institute, established at Stanford University, by the Carnegie Corporation.

According to the *Entomologists Monthly Magazine*, the following English Entomologists have died during the past year:—Dr. Herbert Henry Corbett, of Doncaster, January 5, 1921, in his 65th year: John William Carter, of Bradford, December 15, 1920 aged 67: and John Clarke Hawkshaw, of Hollycombe, February 12, 1921, in his 80th year; All were interested in the Microlepidoptera and in other orders of insects.

Dr. R. W. Leiby has returned to his position as Assistant Entomologist in investigations for the North Carolina Department of Agriculture and Experiment Station after spending the fall and winter months as a graduate student in Entomology at Cornell University. The Degree of Doctor of Philosophy was conferred upon Mr. Leiby by Cornell at its recent commencement. Dr. Leiby's thesis subject concerned insect Polyembryony.

The Experiment Station Record announces that a new scholarship in Entomology has been awarded by the British Ministry of Agriculture and Fisheries, on recommendation of the Advisory Committee on Agricultural Science with the concurrence of the Development Commission. This scholarship is for 200 pounds, for a term of two years, and is available for study at institutions either in England or abroad, subject to the approval of the Ministry.

The honorary degree of Doctor of Science was conferred upon C. L. Marlatt Assistant Chief of the Federal Bureau of Entomology, and Chairman of the Federal Horticultural Board, by the Kansas State Agricultural College at the 58th annual commencement, June 2nd, in recognition of his contributions to our knowledge of insects and his efficient services in initiating the policies and directing the work of the Federal Horticultural Board.

The new apicultural building of the Ontario Agricultural College was formally opened during the annual convention of the Ontario Beekeepers Association. It is a two-story building of tapestry brick about 65 x 47 feet in size, and cost about $60, 000.00. The lower floor cantains offices, a reading room and a microscopical laboratory, and the second floor has a lecture room seating 250 persons. The basement contains a honey and wax room, and bee cellar with special devices for ventilation and heat control.

According to *Science*, the government of Panama has purchased a bronze bust of the late General William C. Gorgas, which will be placed at the entrance of the Santo Tomas Hospital at Panama. The journal of the American Medical Association

states that President Porras of Panama, in writing to the English sculptor in charge of the work, P. Byrant Baker, has stated, "We appreciate very deeply the sanitary work accomplished by Dr. Gorgas in Panama and feel this is one of the most appropriate ways of showing our gratitude."

Appointments to the Bureau of Entomology have been announced as follows, R. W. Allen, Mexican bean beetle, Birmingham, Ala: E. S. Roberts, Kingsville: Texas: William D. Mecum, Madison, Wis. G. Fletcher, Baton Rouge, La: J. D. Waugh, F. I. Jeffrey, E. G. Small, G. B. Warren, H. L. Weatherby, district inspectors, Mexican bean beetle: C. H. Batchelder, Presque Isle, Me: A. D. Shaftesbury and J. B. Moorman of Johns Hopkins University, experiments in apiculture: John Stuart Pinckney, Clemson College, S. C., to Wichita, Kans., D. M. Dowell, Jr., M. P. Foshee, R. H. Turner, W. P. Whitlock, Mexican bean beetle control: F. M. Hull, Kingsville, Texas, J. W. McGlamery, Florida, sweet potato weevil work; J. I. Hambleton, apriculture, Washington, D. C; H. F. Wickam, Iowa, temporary, to visit Mexico to procure natural enemies of the Mexican bean beetle.

(Additional Appointments U. S. Bureau of Entomology). B. G. Sitton, Ala. State Plant Board, temporarily to Federal Horticultural Board to organize the co-operation of railroad and common carriers in Alabama with respect to the enforcement of Federal Quarantine No. 50; Fred P. Bickley, T. F. Catchings, F. R. White, L. W. Brannon, M. H. Atwood, O. Z. Smith, H. B. Lancaster, District Inspectors; James R. Douglass, Clemson College, research work on Mexican bean beetle in Alabama; W. A. Thomas to investigate truck crop insects in the vicinity of Chadbourn, N. C; Melville Kearney, John W. Couch, Richard H. Flake, Adolph Thomas, boll weevil force, Tallulah, La.

There was held at Geneva, N. Y. on August 4, a conference of phytopathologists and entomologists of the north-eastern apple-growing section, who are especially interested in dusting for the control of injurious insects and plant diseases. The chief feature of the program was the examination of dusting and spraying experiments for the control of the more common pests that attack cabbage, potato, currant and apple. The experiments were projected through the agency of the Crop Protection Institute. Following the inspection of the dusting experiments at North Rose, the representatives from different states reported the principal results of their efforts to date, after which Mr. C. H. Popenoe of the U. S. Bureau of Entomology gave an interesting account of his recent experiences with the Mexican Bean Beetle. The following were present: A. C. Baker, C. H. Popenoe, Washington, D. C.; Anthony Berg, Morgantown, W.Va, T. L. Guyton, Harrisburg, Pa.; R. C. Walton, H. W. Thurston, H. E. Hodgkiss, State College, Pa., Robert Matheson, M. D. Leonard, Ithaca, N. Y., E. M. Stoddard, New Haven, Conn.; P. J. Parrott, Hugh Glasgow, G. F. Macleod and W. O. Gloyer, Geneva, N. Y. The Grasselli Chemical Company, The Tobacco By-Products & Chemical Corporation, Louisville, Ky., The Niagara Sprayer Company, and the Friend Manufacturing Company, also sent representatives.

The Eighth Annual Convention of the New Jersey Mosquito Extermination Association met at Atlantic City April 28 to 30.

About 75 delegates were in attendance at the meeting. Practically all of the salt marsh in Bergen, Hudson, Essex, Union and Monmouth counties has been drained. Considerable drainage remains to be done in Middlesex, Ocean, Atlantic and Cape May, Burlington, Camden, Salem and Cumberland counties.

Dr. J. G. Lipman, Director of the Experiment Station, urged the organization of mosquito extermination commissions in these and other counties not active in mosquito control.

At the present rate of progress, Dr. Thomas J. Headlee, secretary of the association declares it will require 15 years to complete the drainage of all the salt marshes. By raising sufficient funds to undertake the work on a large scale, however, it is estimated that the work can be completed in three years. It is believed that a state appropriation of $250,000 a year for 3 years, or a total of $750,000 would be sufficient to finish the job. This may seem like a large amount of money but is is believed that it would be one of the best investments the state could make. Dr. Headlee estimates that an increase in the valuation of taxable properties of $500,000,000 within a period of 30 years would follow the eradication of the mosquito.

The officers of the association elected for the ensuing year are: President, Charles Lee Myers, Jersey City; Vice-President, Wilfred A. Manchee, Newark; Second Vice-President, Joseph Camp Pierces; Secretary, Thomas J. Headlee, New Brunswick; Assistant Secretary, Wilber Walder, New Brunswick, and Treasurer, Lewis W. Jackson, Jersey City; Executive Committee, Robert F. Engle, Beach Haven; Walter R. Hudson, Paterson; Andrew J. Rider, Hammonton; Ralph Hunt, East Orange; Reid Howell, Rutherford; W. H. Randolph, Rahway, and William Edgar Darnall, Atlantic City.

Entomologists of Northeastern United States and Canada.

The summer meeting was held at Boston on July 20th and 21st. The first day was given over to:

(1) The inspection of the large cyanide fumigation plant of the Vacuum Company of Somerville, Mass., in the course of which the process of fumigating cotton was illustrated;

(2) The examination of the results of the work and of the control of the satin moth;

(3) Examination of the work of the European corn borer on sweet corn primarily;

(4) Visit to the gipsy moth parasite laboratory where the process of rearing natural enemies could be seen and many of the operations observed.

The evening was spent at Bass Point, Massachusetts and after dinner a regular program was taken up.

Before the regular program Chairman Britton introduced the Assistant Secretary of Agriculture, Dr. E. D. Ball, who had recently been made Budget Officer of the U. S. Department of Agriculture. He asked Dr. Ball to give to the members present such a message as he thought fitting. Dr. Ball said among other things, "That the U. S. Department of Agriculture proposes that its scientific men shall be encouraged to take leave of absence for graduate courses of such a character as will be

accepted for credit in the Universities. Dr. Ball pointed out that the work of General Dawes was not likely in any way to interfere with the progress of the Department but rather would tend to make it a stronger and a better Department of Agriculture.

Chairman Britton then requested Mr. Burgess to make an announcement, and Mr. Burgess reported that the sum of $300.00 was now ready for distribution among the members who had loaned $25.00 each. The distribution of the sum was effected by lot.

The Chairman then called on Mr. Burgess to present "The Present Status of the Gipsy and Brown Tail Moths". Mr. Burgess reviewed the conditions in New Jersey, Pennsylvania, New York and New England. He said in part that there was no stripping in the New Jersey area and that caterpillars were extremely scarce as the end of the season approached. The same condition obtained in the Pennsylvania and New York infested areas. There was more stripping in the New England area than formerly. This condition he believed to be due to the absence of natural enemies. Parasites that did most of the work belong to the species that develop late. He pointed out that the brown tail moth had decreased from an area of 35,000 square miles to 20,000 square miles. This year the insect seemed to have greatly increased. There was a less marked increase in 1920. This year there have been some heavy flights at Portsmouth and Dover, N. H.

Mr. C. H. Hadley requesetd information on the actual damage done by defoliation particularly of deciduous trees. Mr. Burgess replied that much data had been collected relative to this situation but had not as yet been summarized He said that three strippings in consecutive years usually kills ordinary deciduous trees.

Mr. Crosby wanted to know the cause of increase of the brown tail moth. Mr. Burgess said the increase was due he thought to neglect of measures of control and to a less effective low temperature.

The Chairman then called for Mr. Caffrey's paper on recent developments in the life history of the European corn borer. Mr. Caffrey indicated that existence of two broods in New England and only one outside might be due to different strains of the insect. He showed that adults do not distribute ordinarily on winds of any character. Local work against the insect in many cases seems to be quite effective. Water drift of infested material seems to be largely responsible for local increases in area. Larvae can stand total submergence in fresh or salt water for 36 days. The insect has proven much more resistent when dormant. Extremely early planted sweet corn is badly infested. The next planting normally escapes and late plantings of early varieties are usually badly infested. Late varieties are badly injured. A large percentage of the borers are destroyed by plowing under. Removal and burning of infested material is still more effective. Spring plowing has proven useless. Egg parasites are effective on occasion. Introduced parasites have been distributed but there are no results as yet.

The Chairman then called on Mr. Worthley to present his discussion on "Field Methods of Controlling the European Corn Borer". Mr. Worthley said that field control on a large scale had not yet had a test because funds had not been sufficiently continuous. He believed that a large and complete test covering a period of years

should be made. An area of 5 square miles was treated in New York, but the data from that work was not yet available. Quarantine seems to have given practical results. The restrictions proposed in the quarantine have proven practicable.

Chairman Britton then called on Mr. Burgess to give an account of the satin moth. Mr. Burgess stated that the gipsy moth parasites are also attacking the satin moth. This moth is not considered a serious pest in Europe. Effort is being made to prevent the insect escaping from its present area of distribution.

The Committee on Nominations, appointed at the beginning of the session, recommended Thomas J. Headlee, as Chairman and S. S. Crossman as Secretary. These officers were elected and instructed to call the next summer meeting at the place and time decided upon by them.

The next day was given over to an examination of the large scale work against the gipsy moth. Stripped areas which were refoliating were examined. Deciduous trees that had died under successive defoliation were seen and the operation of a large gipsy moth sprayer was demonstrated.

The following men attended the meetings:
Edward Anderson, J. T. Ashworth, E. D. Ball, George Barber, W. E. Britton K. E. Buffington, A. F. Burgess, H. N. Butler, D. J. Caffery, W. P. Colvin, D. G. Craig, C. R. Crosby, S. S. Crossman, S. M. Dohanian, W. O. Ellis, R. C. Ellis, E. P. Felt, E. L. Fitzhenry, H. L. Frost, P. Garman, F. W. Garver, M. Guptill, C. H. Hadley, J. E. Halbrook, T. J. Headlee, B. E. Hodgson, J. L. Horsfall, D. J. Jones, D. W. Jones, F. V. Learoyd, M. D. Leonard, C. N. Lewis, P. R. Lowry, H. U. Manchester, H. L. McIntyre, C. A. McIsaac, D. G. Memphing, James Moloy, H. Morson, F. J. Mosher, W. C. O'Kane, H. L. Parker, P. J. Parrott, Alvah Peterson, Saul Phillips, B. A. Porter, T. R. Richardson, D. M. Rogers, F. W. Rosse, L. M. Scott, J. V. Shaffner, Jr., M. T. Sherman, George Smith, G. A. Smith, R. I. Smith, M. T. Smulyan, J. N. Summers, C. L. Towler, R. A. Vickery, F. Viddler, B. H. Walden, R. W. Walton, R. W. Wooldridge, L. H. Worthley, M. P. Zappe.

THOMAS J. HEADLEE, *Secretary*